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ABSTRACT

This 10 unit manual introduces the concepts and components of mastery learning and helps instructors organize mastery learning courses of their own. Unit I introduces mastery learning as a process involving the development and presentation of objectives, homework, formative evaluation, corrective assignments, evaluation retakes, and summative evaluation. This unit also presents Carroll's model for school learning and summarizes the first decade of mastery learning's use in the City Colleges of Chicago (CCC). Unit II studies the cognitive and affective entry characteristics of students and their affect on performance in a new learning situation. Unit III outlines the use of learning objectives in a mastery learning course and presents Bloom's and Gagne's taxonomies of student objectives. After Unit IV covers the preparation of learning objectives, Unit V describes the role and incorporation of formative evaluation in the mastery learning course. Next, Unit VI discusses the use of corrective techniques, which provide individualized instruction corresponding to learning difficulties revealed by formative evaluations. Unit VII deals with the development of retake test items to assess the impact of correctives. Unit VIII considers ways of developing summative evaluation to, for example, assign grades. Following Unit IX's discussion of CCC's Mastery Learning Project, Unit X presents a critique of mastery learning as an educational theory and teaching strategy. A bibliography and mastery learning teaching methods scale are appended. (HB)

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MASTERY LEARNING WORKBOOK 1982

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UNIT I

INTRODUCTION TO MASTERY LEARNING

OVERVIEW FOR UNIT I

This unit includes and introduction to Mastery Learning and a summary of Mastery Learning theory. It will also help instructors using this book as a reference to organize Mastery Learning courses of their own.

Mastery Learning is an instructional strategy designed to raise the performance of most students to the levels of academic achievement previously attained only by "A" students. Mastery Learning helps students to learn by dividing the whole course into smaller "learning units," by specifying unit objectives, by providing students with accurate and frequent feedback on their learning progress, and by prescribing and providing alternative learning experiences (correctives) for those students who need them. It is a highly structured approach to classroom learning which attempts to provide the optimum conditions for student learning, thereby allowing mastery to be achieved within the traditional semester.

Dr. Benjamin Bloom, University of Chicago, developed the Mastery model used in the City Colleges of Chicago. As a teaching philosophy which asserts that under appropriate learning conditions virtually all students can learn well what the schools have to teach, Mastery is not a new idea. The concept appears in various forms in the writings of ancient philosophers and mathematicians, later, it was incorporated into the pedagogy of Jesuit schools; and still later it appears in the writings of philosophers such as Pestalozzi and Hebart and educators such as Washburne and Morrison. The current resurgence of interest in Mastery Learning can be traced to John Carroll's article, "A Model of School Learning" (1963), in which he argues that aptitude can be equated to learning rate. In 1968, Dr. Bloom expanded Carroll's model and developed a classroom application which he described in his article, "Learning for Mastery." Both of these readings are included in this unit. There is also a schematic of Mastery Learning and a short summary of the history of Mastery Learning in the City Colleges of Chicago.

As instructors you will be guided through the first steps of setting up a Mastery Learning course. You will be asked to develop a topical outline of your Mastery Learning course.

OBJECTIVES FOR UNIT I

1.1 Translate and interpret the Schematic for Mastery Learning.

1.2 Identify the main ideas of Bloom's "Learning for Mastery."

1.3 Define the five elements of Carroll's Model of School Learning.

1.4 Recall Carroll's formula for the Degree of School Learning.

1.5 Describe personal experiences with Mastery Learning.

1.6 Develop topical outlines for each of the lessons for your Mastery Learning course.

THE SCHEMATIC FOR MASTERY LEARNING

The Schematic for Mastery Learning (see Figure 1.1) is a useful guide for teachers who are implementing Mastery Learning in the classroom.

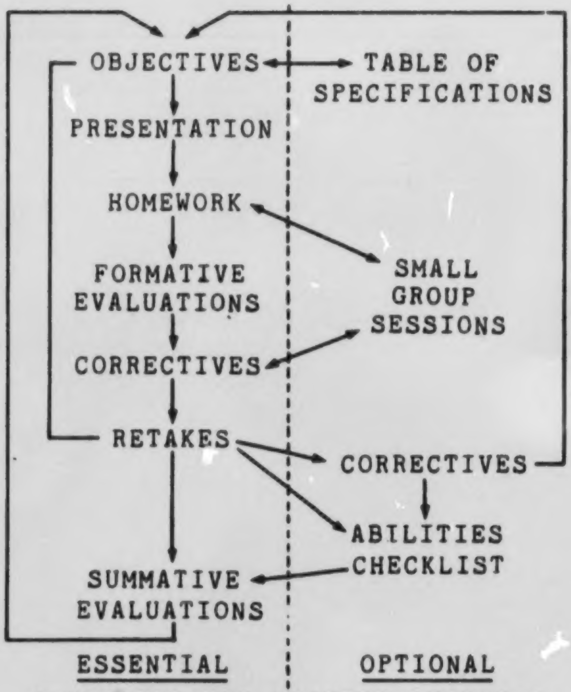
The implementation process begins when the teacher presents the objectives for each learning unit to students during the first class period to let them know what will be covered in the course. In addition, teachers organize a "table of specifications" which arranges the course materials in a sequence so that the cognitive prerequisites for later units are covered in earlier units.

Teachers then present the materials for each lesson and give homework assignments for each class period. In Mastery Learning, homework assigments are detailed and explicit.

After each learning unit, teachers administer formative quizzes to determine if the students have mastered the unit. Those students who do not achieve mastery should be directed to alternative learning experiences to correct the deficiencies revealed by the formative quiz. These "correctives" should correspond to the specific items on the quiz. Teachers then determine if the correctives have remedied the students' deficiencies by administering a retake. The retakes parallel the items on the formative quiz. If the students do not demonstrate mastery on the retake, teachers should give them more intensive remediation. At this point, correctives can be given again.

Finally, teachers will administer a summative test (mid-term and final) to determine the students' final grades. It is helpful to give students an "ability checklist" before the summative test to help them prepare for it.

Mastery Learning


OBJECTIVES
TABLE OF SPECIFICATIONS
PRESENTATION
HOMEWORK
FORMATIVE EVALUATIONS
SMALL GROUP SESSIONS
CORRECTIVES
RETAKES
CORRECTIVES
ABILITIES CHECKLIST
SUMMATIVE EVALUATIONS
ESSENTIAL
OPTIONAL

SCHEMATIC FOR MASTERY LEARNING

FIGURE 1.1

EXERCISE 1.1

Write the definitions of the terms in the Schematic in your own words.

LEARNING FOR MASTERY

Each teacher begins a new term (or course) with the expectation that about a third of his students will adequately learn what he has to teach. He expects about a third of his students to fail or to just "get by." Finally, he expects another third to learn a good deal of what he has to teach, but not enough to be regarded as "good students." This set of expectations supported by school policies and practices in grading becomes transmitted to the students through the grading procedures and through the methods and materials of instruction. The system creates a self-fulfilling prophecy such that the final sorting of students through the grading process becomes approximately equivalent to the original expectations.

This set of expectations, which fixes the academic goals of teachers and students, is the most wasteful and destructive aspect of the present educational system. It reduces the aspirations of both teachers and students; it reduces motivation for learning in students; and it systematically destroys the ego and self-concept of a sizable group of students who are legally required to attend school for 10 to 12 years under conditions which are frustrating and humiliating year after year. The cost of this system in reducing opportunities for further learning and in alienating youth from both school and society is so great that no society can tolerate it for long.

Most students (perhaps over 90 percent) can master what we have to teach them, and it is the task of instruction to find the means which will enable our students to master the subject under consideration. Our basic task is to determine what we mean by mastery of the subject and to search for the methods and materials which will enable the largest proportion of our students to attain such mastery.

In this paper we will consider one approach to learning for mastery and the underlying theoretical concepts, research findings, and techniques required. Basically, the problem of developing a strategy for mastery learning is one of determining how individual differences in learners can be related to the learning and teaching process.

Background

Some societies can utilize only a small number of highly educated persons in the economy and can provide the economic support for only a small proportion of the students to complete secondary or higher education. Under such conditions much of the effort of the schools and the external examining system is to find ways of rejecting the majority of students at various points in the educational system and to discover the talented few who are to be given advanced educational opportunities. Such societies invest a great deal more in the prediction and selection of talent than in the development of such talent.

The complexities of the skills required by the work force in the United States and in other highly developed nations means that we can no longer operate on the assumption that completion of secondary and advanced education is for the few. The increasing evidence, Schultz (1963) and Bowman (1966), that investment in the education of humans pays off at a greater rate than does capital investment suggests that we cannot return to an economy of scarcity of educational opportunity.

Whatever might have been the case previously, highly developed nations must seek to find ways to increase the proportion of the age group that can successfully complete both secondary and higher education. The problem is no longer one of finding the few who can succeed. The basic problem is to determine how the largest proportion of the age group can learn effectively those skills and subject matter regarded as essential for their own development in a complex society.

However, given another set of philosophic and psychological presuppositions, we may express our concern for the intellectual and personality consequences of lack of clear success in the learning tasks of the school. Increasingly, learning throughout life (continuing learning) will be necessary for the largest proportion of the work force. If school learning is regarded as frustrating and even impossible by a sizable proportion of students, then little can be done at later levels to kindle a genuine interest in further learning. School learning must be successful and rewarding as one basis for insuring that learning can continue throughout one's life as needed.

Even more important in modern society is the malaise about values. As the secular society becomes more and more central, the values remaining for the individual have to do with hedonism, interpersonal relations, self-development, and ideas. If the schools frustrate the students in the latter two areas, only the first two are available to the individual. Whatever the case may be for each of these values, the schools must strive to assure all students of successful learning experiences in the realm of ideas and self-development.

There is little question that the schools now do provide successful learning experiences for some students - perhaps as high as one third of the students. If the schools are to provide successful and satisfying learning experiences for at least 90 percent of the students, major changes must take place in the attitudes of students, teachers, and administrators: changes must also take place in teaching strategies and in the role of evaluation.

The Normal Curve

We have for so long used the normal curve in grading students that we have come to believe in it. Our achievement measures are designed to detect differences among our learners, even if the differences are trivial in terms of the subject matter. We then distribute our grades in a normal fashion. In any group of students we expect to have some small percent receive A grades. We are surprised when the percentage differs greatly from about 10 percent. We are also prepared to fail an equal proportion of students. Quite frequently this failure is determined by the rank order of the students in the group rather than by their failure to grasp the essential ideas of the course. Thus, we have become accustomed to classify students into about five categories of level of performance and to assign grades in some relative fashion. It matters not that the failures of one year performed at about the same level as the C students of another year. Nor does it matter that the A students of one school do about as well as the F students of another school.

Having become "conditioned" to the normal distribution, we set grade policies in these terms and are horrified when some teacher attempts to recommend a very different distribution of grades. Administrators are constantly on the alert to control teachers who are "too easy" or "too hard" in their grading. A teacher whose grade distribution is normal will avoid difficulties with administrators. But even more important, we find ways of convincing students that they can only do C work or D work by our grading system and even by our system of quiz and progress testing. Finally, we proceed in our teaching as though only the minority of our students should be able to learn what we have to teach.

There is nothing sacred about the normal curve. It is the distribution most appropriate to chance and random activity. Education is a purposeful activity and we seek to have the students learn what we have to teach. If we are effective in our instruction, the distribution of achievement should be very different from the normal curve. In fact, we may even insist that our educational efforts have been unsuccessful in the extent to which our distribution of achievement approximates the normal distribution.

"Individual differences" in learners is a fact that can be demonstrated in many ways. That our students vary in many ways can never be forgotten. That these variations must be reflected in learning standards and achivement criteria is more a reflection of our policies and practices rather than the necessities of the case. Our basic task in education is to find strategies which will take individual differences into consideration but which will do so in such a way as to promote the fullest development of the individual.

The Variables for Mastery Learning Strategies

A learning strategy for mastery may be derived from the work of Carroll (1963), supported by the ideas of Morrison (1926), Bruner (1966), Skinner (1954), Suppes (1966), Goodlad and Anderson (1959), and Glaser (1968). In presenting these ideas we will refer to some of the research findings which bear on them. However, our main concern here is with the major variables in a model of school learning and the ways in which these variables may be utilized in a strategy for mastery learning.

Put in its most brief form the model proposed by Carroll (1963) makes it clear that if the students are normally distributed with respect to aptitude for some subject (mathematics, science, literature, history, etc.) and all the students are provided with exactly the same instruction (same in terms of amount of instruction, quality of instruction, and time available for learning), the end result will be a normal distribution on an appropriate measure of achievement. Furthermore, the relationship between aptitude and achievement will be relatively high (correlations of +.70 or higher are be be expected if the aptitude and achievement measures are valid and reliable). Conversely, if the students are normally distributed with respect to aptitude, but the kind and quality of instruction and the amount of time available for learning are made appropriate to the characteristics and needs of each student, the majority of students may be expected to achieve mastery of the subject. And, the relationship between aptitude and achievement should approach zero. It is this basic set of ideas we wish to develop in the following.

1. Aptitude for Particular Kinds of Learning

We have come to recognize that individuals do differ in their aptitudes for particular kinds of learning and over the years we have developed a large number of aptitude tests to measure these differences. In study after study we have found that aptitude tests are relatively good predictors of achievement criteria (achievement tests or teacher judgments). Thus, a good set of mathematic aptitude tests given at the beginning of the year will correlate as high as +.70 with the mathematics achievement tests given at the end of the course in algebra, or some other mathematics subject.

The use of aptitude tests for predictive purposes and the high correlations between such tests and achievement criteria have led many of us to the view that high levels of achievement are possible only for the most able students. From this, it is an easy step to some notion of a casual connection between aptitude and achievement. The simplest notion of casality is that the students with high levels of aptitude can learn the complex ideas of the subject while the students with low levels of aptitude can learn only the simplest ideas of the subject.

Quite in contrast to this is Carroll's (1963) view that aptitude is the amount of time required by the learner to attain mastery of a learning task. Implicit in this formulation is the assumption that, given enough time, all students can conceivably attain mastery of a learning task. If Carroll is right, then learning mastery is theoretically available to all, if we can find the means for helping each student. It is this writer's belief that this formulation of Carroll's has the most fundamental implications for education.

One type of support for this view is to be found in the grade norms for many standardized achievement tests. These norms demonstrate that selected criterion scores achieved by the top students at one grade level are achieved by the majority of students at a later grade level. Further support is available in studies where students can learn at their own rate. These studies show that although most students eventually reach mastery on each learning task, some students achieve mastery much sooner than do other students (Glaser, 1968; Atkinson, 1967).

Can all students learn a subject equally well? That is, can all students master a learning task at a high level of complexity? As we study aptitude distributions in relation to student performance we have become convinced that there are differences between the extreme students and the remainder of the population. At the top of the aptitude distribution (1 percent to 5 percent) there are likely to be some students who have a special talent for the subject. Such students are able to learn and to use the subject with greater fluency than other students. The student with special aptitudes for music or foreign languages can learn these subjects in ways not available to most other students. Whether this is a matter of native endowment or the effect of previous training is not clear, although this must vary from subject to subject. It is likely that some individuals are born with sensory organs better attuned to sounds (music, language, etc.) than are others and that these constitutional characteristics give them special advantages in learning such subjects over others. For other subjects, special training, particular interests, etc. may develop these high level aptitudes.

At the other extreme of the aptitude distribution, we believe there are individuals with special disabilities for particular learning. The tone deaf individual will have great difficulty in learning music; the color blind individual will have special problems in learning art; the individual who thinks in concrete forms will have special problems in learning highly abstract conceptual systems such as philosophy. Again, we believe these may constitute less than 5 percent of the distribution, but this will vary with the subject and the aptitudes.

In between are approximately 90 percent of the individuals where we believe (as does Carroll) that aptitudes are predictive of rate of learning rather than the level (or complexity) of learning that is possible. Thus, we are expressing the view that, given sufficient time (and appropriate types of help), 95 percent of students (the top 5 percent + the next 90 percent) can learn a subject up to a high level of mastery. We are convinced that the grade of A as an index of mastery of a subject can, under appropriate conditions, be achieved by up to 95 percent of the students in a class.

It is assumed that it will take some students more effort, time, and help to achieve this level than it will other students. For some students the effort and help required may make it prohibitive. Thus, to learn high school algebra to a point of mastery may require several years for some students but only a fraction of a year for other students. Whether mastery learning is worth this great effort for the students who may take several years is highly questionable. One basic problem for a mastery learning strategy is to find ways of reducing the amount of time required for the slower students to a point where it is no longer a prohibitively long and difficult task for these less able students.

We do not believe that aptitude for particular learning tasks is completely stable. There is evidence (Bloom, 1964; Hunt, 1961) that the aptitude for particular learning tasks may be modified by appropriate environmental conditions or learning experiences in the school and the home. The major task of educational programs concerned with learning to learn and general education should be to produce positive changes in the students' basic aptitudes. It is likely that these aptitudes can be most markedly affected during the early years in the home and during the elementary years of school. Undoubtedly, however, some changes can take place at later points in the individual's career.

However, even if marked changes are not made in the individual's aptitudes, it is highly probable that more effective learning conditions can reduce the amount of time required to learn a subject to mastery for all students and especially for the students with lower aptitudes. It is this problem which must be directly attacked by strategies for mastery learning.

2. Quality of Instruction

Our schools have usually proceeded on the assumption that there is a standard classroom situation for all students. Typically, this has been expressed in the teacher-student ratio of 1-30 with group instruction as the central means of teaching. There is the expectation that each teacher will teach the subject in much the same way as other teachers. This standardization is further emphasized by textbook adoption which specifies the instructional material to be provided each class. Closely related to this is the extensive research over the past 50 years which seeks to find the one instructional method, material or curriculum program that is best for all students.

Thus, over the years, we have fallen into the "educational trap" of specifying quality of instruction in terms of good and poor teachers, teaching instructional materials, curriculum - all in terms of group results. We persist in asking such questions as: What is the best teacher for the group? What is the best method of instruction for the group? What is the best instructional material for the group?

One may start with the very different assumption that individual students may need very different types and qualities of instruction to achieve mastery. That is, the same content and objectives of instruction may be learned by different students as the result of very different types of instruction. Carroll (1963) defines the quality of instruction in terms of the degree to which the presentation, explanation, and ordering of elements of the task to be learned approach the optimum for a given learner.

Much research is needed to determine how individual differences in learners can be related to variations in the quality of instruction. There is evidence that some students can learn quite well through independent learning efforts while others need highly structured teaching - learning situations (Congreve 1965). It seems reasonable to expect that some students will need more concrete illustrations and explanations than will others; some students may need more examples to get an idea than do others; some students may need more approval and reinforcement than others; and some students may even need to have several repetitions of the explanation while others may be able to get it the first time.

We believe that if every student had a very good tutor, most of them would be able to learn a particular subject to a high degree. A good tutor attempts to find the qualities of instruction (and motivation) best suited to a given learner. And, there is some evidence (Dave, 1963) that middle-class parents do attempt to tutor their children when they believe that the quality of instruction in school does not enable their children to learn a particular subject. In an unpublished study, the writer found that one-third of the students in an algebra course in a middle-class school were receiving as much tutorial instruction in the home in algebra as they were receiving group instruction in the school. These students received relatively high grades for the algebra course. For these students, the relationship between their mathematics aptitude scores (at the beginning of the year) and their achievement in algebra at the end of the year was almost zero. In contrast, for the students who received no additional instruction other than the regular classroom instruction, the relationship between their mathematics aptitude scores and their algebra achievement scores was very high (+.90). While this type of research needed to be replicated, it is evident in this small study that the home tutoring help was providing the quality of instruction needed by these students to learn the algebra - that is, the instruction was adapted to the needs of the individual learners.

The main point to be stressed is that the quality of instruction is to be considered in terms of its effects on individual learners rather than on random groups of learners. Hopefully, the research of the future may lead to the definition of the qualities and kinds of instruction needed by various types of learnings. Such research may suggest more effective group instruction since it is unlikely that the schools will be able to provide instruction for each learner separately.

3. Ability to Understand Instruction

In most courses at the high school and college level there is a single teacher and a single set of instructional materials. If the student has facility in understanding the teacher's communications about the learning and the instructional material (usually a textbook), he has little difficulty in learning the subject. If he has difficulty in understanding the teacher's instruction and/or the instructional material, he is likely to have great difficulty in learning the subject. The ability to understand instruction may be defined as the ability of the learner to understand the nature of the task he is to learn and the procedures he is to follow in the learning of the task.

Here is a point at which the student's abilities interact with the instructional materials and the instructor's abilities in teaching. For the student in our highly verbal achools it is likely that this ability to understand instruction is primarily determined by verbal ability and reading comprehension. These two measures of language ability are significantly related to achievement in the majority of subjects and they are highly related (+.50 to +.60) to grade point averages at the high school or college level. What this suggests is that verbal ability (independent of specific aptitudes for each subject) determines some general ability to learn from teachers and instructional materials.

While it is possible to alter an individual's verbal ability by appropriate training, there are limits to the amount of change that can be produced. Most change in verbal ability can be produced at the pre-school and elementary school levels with less and less change being likely as the student gets older (Bloom, 1964). Vocabulary and reading ability, however, may be improved to some extent at all age levels, even though there is a diminishing utility of this approach with increasing age. Improvements in verbal abilities should result in improvements in the individual's ability to understnad instruction.

The greatest immediate payoff in dealing with the ability to understand is likely to come from modifications in instruction in order to meet the needs of individual students. There is no doubt that some teachers do attempt to modify their instruction to fit a given group of students. Many teachers center their instruction at the middle group of their students others at the top or bottom group -- these are, however, reflections of the teacher's habits and attitudes. They are, by no means, determinants of what it is possible for a teacher to do. Given help and various types of aids, individual teachers can find ways of modifying their instruction to fit the differing needs of their students.

Group study procedures should be available to students as they need it. In our own experience we have found that small groups of students (two or three students) meeting regularly to go over points of difficulty in the learning process were most effective, especially when the students could cooperate and help each other without any danger of giving each other special advantages in a competitive situation. Where learning can be turned into a cooperative process with everyone likely to gain from the process, small group learning procedures can be very effective. Much depends on the composition of the group and the opportunities it gives each person to expose his difficulties and have them corrected without demeaning one person and elevating another. In the group process, the more able students have opportunities to strengthen their own learning in the process fo helping another person grasp the idea through alternative ways of explaining and using the idea.

Tutorial help (one to one relations between teacher and learner) represents the most costly type of help and should be used only where alternative procedures are not effective. However, this type of should be available to students as they need it, especially where individuals have particular difficulties that can't be corrected in other ways. The tutor, ideally, should be someone other than the teacher, since he should bring a fresh way of viewing the idea or the process. The tutor must be skillful in detecting the points of difficulty in the student's learning and should help him in such a way as to free the student from continued dependence on him.

Another approach to variations in the students' ability to understand instruction is to vary the instructional material.

Textbooks may vary in the clarity with which they explain a particular idea or process. The fact that one textbook has been adopted by the school or by the teacher does not neccessarily mean that other textbooks cannot be used at particular points in the instruction when they would be helpful to a student who can't grasp the idea from the adopted textbook. The task here is to able to determine where the individual student has difficulty in understanding the instructions if they are more effective at that point.

Workbooks and programmed instruction units may be especially helpful for some students who cannot grasp the ideas or procedures in the textbook form. Some students need the drill and the specific tasks which workbooks can provide. Other students need the small steps and frequent reinforcement which programmed units can provide. Such materials may be used in the initial instruction or as students encounted specific difficulties in learning a particular unit or section of the course.

Some students may learn a particular idea best through concrete illustrations and vivid and clear explanations. It is likely that film strips and short motion pictures which can be used by individual students as needed may be very effective. Other students may need concrete material such as laboratory experiences, simple demonstrations, blocks, and other relevant apparatus in order to comprehend an idea or task. Academic games, puzzles, and other interesting but not threatening devices may be useful. Here again, the point is that some ways of communicating and comprehending an idea, problem, or task may be especially effective for some students, although others may not use or need such materials and methods. We need not place the highest priority for all on abstract and verbal ways of instruction.

With regard to instructional materials, the suggestion is not that particular materials be used by particular students thoughout the course. It is that each type of material may serve as a means of helping individual students at selected points in the learning process - and that a particular student may use whatever variety of materials are found to be useful as he encounters difficulties in the learning.

Thoughout the use of alternative methods of instruction and instructional material, the essential point to be borne in mind is that these are attempts to improve the quality of instruction in relation to the abiltiy of each student to understand the instruction. As feedback methods inform the teachers of particular errors and difficulties the majority of students are having, it is to be expected that the regular group instruction could be modified so as to correct these difficulties. As particular students are helped individually, the goal should be not only to help the student over particular learning difficulities but also to enable him to become more independent in his learning and to help him identify the alternative ways by which he can comprehend new ideas. But, most important, the presence of a great variety of instructional materials and procedures should help both teachers and students to overcome feelings of defeatism and passivity about learning. If the student can't learn in one way, he should be reassured that alternatives are available to him. The teacher should come to recognize that it is the learning which is important and that instructional alternatives exist to enable all (or almost all) of the students to learn the subject to a high level.

4. Perseverance

Carroll defines perseverance as the time the learner is willing to spend in learning. If a student needs to spend a certain amount of time to master a particular task, and he spends less than this amount in active learning, he is not likely to learn the task to the level of mastery. Carroll attempts to differentiate between spending time on learning and the amount of time the student is actively engaged in learning.

Perseverance does appear to be related to attitudes toward and interest in learning. In the International Study of Educational Achievement (Husen, 1967), the relationship between the number of hours of homework per week reported by the student (a crude index of perseverance) and the number of years of further education desired by the student is - .25.

We do believe that students vary in the amount of perseverance they bring to a specific learning task. However, students appear to approach different learning tasks with different amounts of perseverance. The student who gives up quickly in his efforts to learn an academic subject may persevere an unusually long time in learning how to repair an automobile or in learning to play a musical instrument. It would appear to us that as a student finds the effort rewarding, he is likely to spend more time on a particular learning task. If, on the other hand, the student is frustrated in his learning, he must (in self-defense) reduce the amount of time he devotes to learning. While the frustration level of students may vary, we believe that all students must sooner or later give up a task if it is too painful for them.

While efforts may be made to increase the amount of perseverance in students, it is likely that manipulation of the instruction and learning materials may be more effective in helping students master a given learning task, in spite of their present level of perseverance. Frequency of reward and evidence of success in learning can increase the student's perseverance in a learning situation. As students attain mastery of a given task, they are likely to increase their perseverance for a related learning task.

In our own research we are finding that the demands for perseverance may be sharply reduced if students are provided with instructional resources most appropriate for them. Frequent feedback accompanied by specific help in instruction and material as needed can reduce the time (and perseverance) required. Improvement in the quality of instruction (or explanations and illustrations) may reduce the amount of perseverance necessary for a given learning task.

There seems to be little reason to make learning so difficult that only a small proportion of the students can persevere to mastery. Endurance and unusual perseverance may be appropriate for long-distance running — they are not great virtues in their own right. The emphasis should be on learning, not on vague ideas of discipline and endurance.

5. Time Allowed for Learning

Thoughout the world schools are organized to have group instruction with definite periods of time located for particular learning tasks. A course in history at the secondary level may be planned for an academic year of instruction, another course may be planned for a semester, while the amount of instructional time allocated for a subject like arithmetic at the 5th-grade level may be fixed. Whatever the amount of time allowed by the school and the curriculum for particular subjects or learning tasks, it is likely to be too much for some students and not enough for other students.

For Carroll, the time spent on learning is the key to mastery. His basic assumption is that aptitude determines the rate of learning and that most, if not all, students can achieve mastery if they devote the amount of time needed to the learning. This implies that the student must not devote the amount of time he needs to the learning task but also that he be allowed enough time for the learning to take place.

There seems to be little doubt that students with high levels of aptitude are likely to be more efficient in their learning and to require less time for learning than students with lower levels of aptitude. Whether most students can be helped to become highly efficient learners in general is a problem for future research.

The amount of time students need for a particular kind of learning has not been studied directly. One indication of the time needed comes from studies of the amount of time students spend on homework. In our review of the amount of time spent by 13-year-old students on mathematics homework in the International Study of Educational Achievement (Husen, 1967), we find that if we omit the extreme 5 percent of the subjects, the ratio is roughly 6 to 1. That is, some students spend 6 times as much time on mathematics homework as do others. Other studies of use of time suggest that this is roughly the order of magnitude to be expected.

If instruction and student use of time become more effective, we believe that most students will need less time to learn the subject to mastery and that the ratio of time required for the slower and the faster learners may be reduced from about 6 to 1 to perhaps 3 to 1.

In general, we find a zero or a slightly negative relationship between final grades and amount of time spent on homework. In the International Study (Husen, 1967) the average correlation for twelve countries at the 13-year-old level is approximately -.05 between achievement test scores in mathematics and number of hours per week of homework in mathematics as reported by students. Thus, the amount of time spent on homework does not seem to be a very good predictor of achievement in the subject.

We are convinced that it is not the sheer amount of time spent in learning (either in school or out of school) that accounts for the level of learning. We believe that each student should be allowed the time he needs to learn a subject. And, the time he needs to learn the subject is likely to be affected by the student's aptitudes, his verbal ability, the quality of instruction he receives in class, and the quality of the help he receives outside of class. The task of a strategy for mastery learning is to find ways of altering the time individual students need for learning as well as to find ways of providing whatever time is needed by each student. Thus, a strategy for mastery learning must find some way of solving the instructional problems as well as the school organizational (including time) problems.

One Strategy for Mastery Learning

There are many alternative strategies for mastery learning. Each strategy must find some way of dealing with individual differences in learners through some means of relating the instruction to the needs and characteristics of the learners. We believe that each strategy must include some way of dealing with the five variables discussed in the foregoing.

Were it not so costly in human resources, we believe that the provision of a good tutor for each student might be one ideal strategy. In any case, the tutor-student relationship is a useful model to consider when one attempts to work out the details of a less costly strategy. Also, the tutor strategy is not as farfetched as it may seem at first glance. In the pre-school period most of the child's instruction is tutorial — usually provided by the mother. In many middle -class homes the parents continue to provide tutorial help as needed by the child during much of his school career.

Other strategies include permitting students to go at their own pace, guiding students with respect to courses they should or should not take, and providing different tracks or streams for different groups of learners. The nongraded school (Goodlad and Anderson, 1959) is one attempt to provide an organizational structure that permits and encourages mastery learning.

A group of us at the University of Chicago have been doing research on the variables discussed in the previous pages. In addition, some of us have been attempting to develop a strategy of teaching and learning which will bring all (or almost all) students to a level of mastery in the learning of any subject. Our approach has been to supplement regular group instruction by using diagnostic procedures and alternative instructional methods and materials in such a way as to bring a large proportion of the students to a predetermined standard of achievement. In this approach, we have tried to bring most of the students to mastery levels of achievement within the regular term, semester, or period of calendar time in which the course is usually taught. Undoubtedly, some students will spend more time than others in learning the subject, but if the majority of students reach mastery levels at the end of the time allocated for the subject, mastery will have affective as well as cognitive consequences.

We have had some successes and some dismal failures with this approach. We have been trying to learn from both the successes and the faulures. In the near future we hope to have some of these ideas applied to a large number of classrooms in selected school systems. Initially, we have chosen to work with subjects which have few prerequisites (algebra, science, etc.) because we believe it is easier to secure mastery learning in a given time period in such courses. In contrast are subjects which are late in a long sequence of learning (6th grade reading, 8th grade arithmetic, advanced mathematics, etc.) For such subjects, it is unlikely that mastery learning can be attained within a term for a group of students who have had a long history of cummalative learning difficulties in the specific subject field.

In working on this strategy we have attempted to spell out some of the preconditions necessary, develop the operating procedures required, and evaluate some of the outcomes of the strategy.

Preconditions

If we are able to develop mastery learning in students, we must be able to recognize when students have achieved it. We must be able to collect the necessary evidence to establish whether or not student has achieved it.

The specification of the objectives and content of instruction is one necessary precondition for informing both teachers and students about the expectations. The translation of the specifications into evaluation procedures helps to further define what it is that the student should be able to do when he has completed the course. The evaluation procedures used to appraise the outcomes of instruction (summative evaluation) help the teacher and student know when the instruction has been effective.

Implicit in this way of defining the outcomes and preparing evaluation instruments is a distinction between the teaching-learning process and the evaluation process. At some point in time, the results of teaching and learning can be reflected in the evaluation of the students. But, these are separate processes. That is, teaching and learning are intended to prepare the student in an area of learning, while evaluation (summative) is intended to appraise the extent in which the student has developed in the desired ways. Both the teacher and the learner must have some understanding of what the achievement criteria are and both must be able to secure evidence of progress toward these criteria.

If the achievement criteria are primarily competitive, i.e., the student is to be judged in terms of his relative position in the group, then the student is likely to seek evidence on his standing in the group as he progresses through the learning tasks. We recognize that competition may be a spur to those students who view others in competitive terms, but we believe that much of learning and development may be destroyed by primary emphasis on competition.

Much more preferable in terms of intrinsic motivation for learning is the setting of standards of mastery and excellence apart from inter-student competition, followed by appropriate efforts to bring as many students up to this standard as possible. This suggests some notion of absolute standards and the use of grades or marks which will reflect these standards. Thus, it is conceivable that all students may achieve mastery and the grade of A. It is also possible in a particular year in a specific course for few or none of the students to attain mastery or a grade A.

While we would recommend the use of absolute standards carefully worked out for a subject, we recognize the difficulty of arriving at such standards. In some of our own work, we have made use of standards derived from previous experience with students in a particular course. In one course, students in 1966 were informed that the grades for 1966 should be based on standards arrived at in 1965. The grades of A, B, C, D, and F, would be based on an examination which was parallel to that used in 1965 and the grades would be set at the same performance levels as those used in 1965. The students were informed that the proportion of students receiving each grade was to be determined by their performance levels rather than by their rank order in the group. Thus, the students were not competing with each other for grades; they were to be judged on the basis of levels of mastery used in 1965.

We do not believe this is the only way of arriving at achievement standards, but the point is that students must feel they are being judged in terms of level of performance rather than a normal curve or some other arbitrary and relative set of standards. We are not recommending national achievement standards. What is being recommended are realistic performance standards developed for each school or group, followed by instructional procedures which will enable the majority of students to attain these standards.

One result of this way of setting achievement standards was to enable the students to work with each other and to help each other without being concerned about giving special advantages (or disadvantages) to other students. Cooperation in learning rather than competition was a clear result from this method of setting achievement criteria.

In the work we have done, we attempted to have the teacher teach the course in much the same way as previously. That is, the particular materials and methods of instruction in the current year should be about the same as in previous years. Also, the time schedule during the course was about the same. The operating procedures discussed in the next section supplemented the regular instruction of the teacher. We have proceeded in this way because we believe a useful strategy for mastery learning should be widely applicable. If extensive training of teachers is necessary for a particular strategy, it is less likely that it will receive widespread use.

Operating Procedures

The operating procedures we have used are intended to provide detailed feedback to teachers and students and to provide specific supplementary instructional resources as needed. These procedures are devised to insure mastery of each learning unit in such a way as to reduce the time required while directly affecting both quality of instruction and the ability fo the student to understand the instruction.

Formative Evaluation. One useful operating procedure is to break a course or subject into smaller units of learning. Such a learning unit may correspond to a chapter in a textbook, a well-defined content portion of a course, or a particular time unit of the course. We have tended to think of units as involving a week or two of learning activity.

Using some of the ideas of Gagne (1965) and Bloom (1956) we have attempted to analyze each unit into a number of elements ranging from specific terms or facts, more complex and abstract ideas such as concepts and principles, and relatively complex processes such as application of principles and analysis of complex theoretical statements. We believe, as does Gagne (1965) that these elements form a hierarchy of learning tasks.

We have then attempted to construct brief diagnostic-progress tests which can be used to determine whether or not the student has mastered the unit and what, if anything, the student must still do to master it. We have borrowed the term Formative Evaluation from Scriven (1967) to refer to these diagnostic-progress tests.

Freqent formative evaluation tests pace the learning of students and help motivate them to put forth the necessary effort at the appropriate time. The appropriate use of these tests helps to insure that each set learning tasks is thoroughly mastered before subsequent learning tasks are started.

Each formative test is administered after the completion of the appropriate learning unit. While the frequency of these progress tests may vary throughout the course, it is likely that some portions of the course — especially the early sections of the course — may need more frequent formative tests than later portions. Where some of the learning units are basic and prerequiste for other units of the course, the test should be frequent enough to insure thorough mastery of such learning material.

For those students who have thoroughly mastered the unit, the formative tests should reinforce the learning and assure the student that his present mode of learning and approach to study is adequate. Since he will have a number of such tests, the student who consistently demonstrates mastery should be able to reduce his anxiety about his course achievement.

For students who lack mastery of a particular unit, the formative tests should reveal the particular points of difficulty — the specific questions they answer incorrectly and the particular ideas, skills, and processes they still need to work on. It is most helpful when the diagnosis shows the elements in a learning hierarchy that the student still needs to learn. We have found that students respond best to the diagnostic results when they are referred to particular instructional materials or processes intended to help them correct their difficulties. The diagnosis should be accompanied by a very specific prescription if the students are to do anything about it.

Although we have limited evidence on this point, we believe that the formative tests should not be assigned grades or quality points. We have marked the tests to show mastery and non-mastery. The non-mastery test is accompanied by detailed diagnosis and prescription of what is yet to be done before mastery is complete. We believe that the use of grades on repeated progress tests prepares students for the acceptance of less than mastery. To be graded C repeatedly prepares the student to accept a C as his "fate" for the particular course, especially when the grades on progress tests are averaged in as part of the final grade. Under such conditions, there must come a point when it is impossible to do better than a particular grade in the course and there is little value in striving to improve. Formative evaluation tests should be regarded as part of the learning process and should in no way be confused with the judgment of the capabilities of the student or used as a part of the grading process.

These formative tests may also provide feedback for the teacher since they can be used to identify particular points in the instruction that are in need of modification. The formative evaluation tests also can serve as a means of quality control in future cycles of the course. The performance of the students on each test may be compared with the norms for previous years to insure that students are doing aswell or better. Such comparisons can also be used to insure that changes in instruction or materials are not producing more error and difficulty than was true in a previous cycle of the course.

Alternative Learning Resources. It is one thing to diagnose the specific learning difficulties the student has and to suggest the specific steps he should take to overcome these difficulties. It is quite another thing to get him to do anything about it. By itself, the frequent use of progress tests can improve the achievement of students to a small degree. If, in addition, the student can be motivated to expend further effort on correcting his errors on the progress tests, the gains in achievement can be very great.

We have found that students do attempt to work on their difficulties when they are given specific suggestions (usually on the formative evaluation results) as to what they need to do.

The best procedure we have found thus far is to have small groups of students (two or three) meet regularly for as much as an hour per week to review the results of their formative evaluation tests and to help each other overcome the difficulties identified on these tests.

We have offered tutorial help as students desired it, but so far students at the secondary or higher education level do not seek this type of help frequently.

Other types of learning resources we have prescribed for students include: a) rereading a particular page of the original instructional materials; b) reading study specific pages in alternative textbooks or other instructional materials; c) using specific pages of workbooks or programmed texts; and d) use selected audiovisual materials.

We suspect that no specific learning material or process is indispensable. The presence of great variety of instructional materials and procedures and specific suggestions as to which ones the student might use help the student recognize that if he cannot learn in one way, alternatives are available to him. Perhaps further research will reveal the best match between individuals and alternative learning resources. At present, we do not have firm evidence on the relations between student characteristics and instructional materials and procedures.

Outcomes

What are the results of a strategy for mastery learning? So far we have limited evidence. The results to date, however, are very encouraging. We are in the process of securing more evidence on a variety of situations at the elementary, secondary, and higher education levels.

Cognitive Outcomes of a Mastery Strategy. In our work to date we have found some evidence of the effectiveness of a strategy for mastery learning. Our best results have been found in a course on test theory where we have been able to use parallel achievement tests for the course in 1965, 1966, and 1967. In 1965, before the strategy was used, approximately 20 percent of the students received the grade of A on the final examination. In 1966, after the strategy was employed, 80 percent of the students reached this same level of mastery on the parallel examination and were given the grade of A. The difference in the mean performance of the two groups represents about two standard deviations on the 1966 achievement test and is highly significant.

In 1967, using the same formative evaluation tests as used in 1966, it was possible to compare the 1966 and the 1967 results after each unit of learning. Thus the formative evaluation tests became quality control measures. Where there were significant negative differences between the results on a particular test from 1966 to 1967, the instructor reviewed the specific learning difficulties and attempted to explain the ideas in a different way. The final results on the 1967 summative evaluation instrument, which was parallel to the final achievement tests in 1965 and 1966, were that 90 percent of the students achieved mastery and were given grades of A.

Similar studies are underway at different levels of education. We expect to have many failures and a few successes. But, the point to be made is not that a single strategy of mastery learning can be used mechanically to achieve a particular set of results. Rather, the problem is one of determining what procedures will prove effective in helping particular students learn the subject under consideration. It is hoped that each time a strategy is used, it will be studied to find where it is succeeding and where it is not. For which students is it effective and for which students is it not effective? Hopfully, the results in a particular year can take advantage of the experience accumulated over the previous years.

Affective Consequences of Mastery. We have for the past century conceived of mastery of a subject as being possible for only a minority of students. With this assumption we have adjusted our grading system so as to certify that only a small percent of students (no matter how carefully selected) are awarded a grade of A. If a group of students learns a subject in a superior way (as contrasted with a previous group of students) we still persist in awarding the A (or mastery) to only the top 10 or 15 percent of the students. We grudgingly recognize that the majority of students have "gotten by" by awarding them grades of D or C. Mastery and recognition of mastery under the present relative grading system unattainable for the majority of students - but this is the result of the way in which we have "rigged" the educational system.

Mastery must be both a subjective recognition by the student of his competence and a public recognition by the school or society. The public recognition must be in the form of appropriate certification by the teacher or by the school. No matter how much the student has learned, if public recognition is denied him, he must come to believe that he is inadequate, rather than the system of grading or instruction. Subjectively, the student must gain feelings of control over ideas and skills. He must come to recognize that he "knows" and can do what the subject requires.

If the system of formative evaluation (diagnostic-progress tests) and the summative evaluation (achievement examinations) informs the student of his mastery of the subject, he will come to believe in his own mastery and competence. He may be informed by the grading system as well as by the discovery that he can adequateely cope with the variety of tasks and problems in the evaluation instruments.

When the student has mastered a subject and when he receives both objective and subjective evidence of the mastery, there are profound changes in his view of himself and of the outer world.

Perhaps the clearest evidence of affective change the interest the student develops for the subject he has mastered. He begins to "like" the subject and to desire more of it. To do well in a subject opens up further avenues for exploration of the subject. Conversely, to do poorly in subject closes an area for further study. The student desires some control over his environment, and mastery of a subject gives him some feeling of control over a part of his environment. Interest in a subject is both a cause of mastery of the subject as well as a result of mastery. Motivation for further learning is one of the more important consequences of mastery.

At a deeper level is the student's self-concept. Each person searches for positive recognition of his worth and he comes to view himself as adequate in those areas where he receives assurance of his competence or success. For a student to view himself in a positive way, he must be given many opportunities to be rewarded. Mastery and its public recognition provide the necessary reassurance and reinforcement to help the student view himself as adequate. It is the opinion of this writer that one of the more positive aids to mental health is frequent and objective indications of self-development. Mastery learning can be one of the more powerful sources of mental health. We are convinced that many of the neurotic symptoms displayed by high school and college students are exacerbated by painful and frustrating experiences in school learning. If 90 percent of the students are given positive indications of adequacy in learning, one might expect such students to need less and less in the way of emotional therapy and psychological help. Contrariwise, frequent indications of failure and learning inadequacy must be accompanied by increased self-doubt on the part of the student and the search for reassurance and adequacy outside the school.

Finally, modern society requires continual learning throughout life. If the schools do not promote adequate learning and reassurance of progress, the student must come to reject learning — both in the school and later life. Mastery learning can give zest to school learning and can develop a lifelong interest in learning. It is this continual learning which should be the major goal of the educational system.

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SOURCE:
Bloom, Benjamin S., "Learning for Mastery," UCLA Evaluation Comment, May 1968, Vol. 1 No. 2.

Exercise 1.2

Answer the following questions on Benjamin Bloom's article, "Learning for Mastery." This exercise will help you meet objective 1.2.

1. Why does Bloom object to using the normal curve in grading students?
2. What are the variables for Mastery Learning?
3. How can instruction be varied to meet the needs of the individual?
4. What are absolute standards?
5. How can Mastery Learning change a student's attitude toward learning?

CARROLL'S MODEL FOR SCHOOL LEARNING

John B. Carroll's "A Model of School Learning," which follows, is important to Mastery Learning theory because of its thesis that there are no "good" students and "bad" students, but merely students who learn at different rates of speed.

In Carroll's view, the amount of learning that is accomplished depends on five factors:

1. Opportunity to learn — the time allowed for learning to take place
2. Perseverance — the amount of time the learner is willing to spend actually engaged in the learning
3. Aptitude — the amount of time the learner needs to attain mastery of the task under optimal instructional conditions
4. Ability to understand instruction — the ability of the learner to understand what is to be learned and the steps he is to follow in order to learn the task
5. Quality of instruction — the degree to which instruction is optimal for a given learner on a given task.

According to Carroll, the degree of learning is directly proportional to the time spent in learning and inversely proportional to the time needed to learn. The diagram below shows the relation of the variables in Carroll's model, and should help you to follow "A Model of School Learning."

INFLUENCE DIAGRAM DEPICTING THE
VARIABLES IN THE CARROLL MODEL

$$\text{DEGREE OF LEARNING} = F\,\frac{\text{TIME SPENT}}{\text{TIME NEEDED}}$$

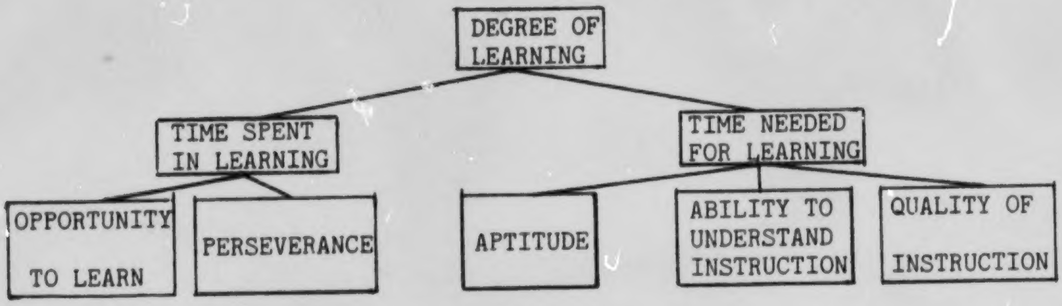

Figure 1.2

FROM

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A MODEL

OF

SCHOOL LEARNING

by

John B. Carroll
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The primary job of the educational psychologist is to develop and apply knowledge concerning why pupils succeed or fail in their learning at school, and to assist in the prevention and remediation of learning difficulties.

This job is inherently difficult because behavior is complex and has a multiplicity of causes. To deal with it, educational psychologists have evolved a number of concepts which they find useful in classifying the phenomena of behavior. Textbooks in the field are commonly organized around such concepts as maturation, individual differences, learning, thinking, motivation, and social development. These are useful categories, but because they overlap or refer to different levels of organization in the subject matter, it is difficult to build them into an integrated account of the process of school learning. What is needed is a schematic design or conceptual model of factors affecting success in school learning and of the way they interact. Such a model should use a very small number of simplifying concepts, conceptually independent of one another and referring to phenomena at the same level of discourse. It should suggest new and interesting research questions and aid in the solution of practical educational problems. With the aid of such a framework, the often conflicting results of different research studies might be seen to fall into a unified pattern. Many such formulations, perhaps, are possible. A conceptual model will be presented here that seems to have the advantage of comprehensiveness combined with relative simplicity. The model is amenable to elaboration, but for our immediate purpose, we will leave aside any such elaborations.

Scope of the Model

We need first to define learning task. The learner's task of going from ignorance of some specified fact or concept to knowledge or understanding of it, or of proceeding from incapability of performing some specified act to capability of performing it, is a learning task. To call it a task does not necessarily imply that the learner must be aware that he is supposed to learn, or be aware of what he is to learn, although in most cases it happens that such awarenesses on the part of the learner are desirable.

Most, but not all, goals of the school can be expressed in the form of learning tasks or a series of such tasks. Teaching the child to read, for example, means to teach him to perform certain acts in response to written or printed language. Examples of other learning tasks taught in the schools can be multiplied at will: learning to spell all the words in common use, learning to perform certain operations with numbers, learning to explain or otherwise demonstrate an understanding of the subject matter of biology, learning to speak a foreign language, learning to perform in competitive sports, and learning to carry out certain responsibilities of a citizen. Some of these tasks are very broadly defined, such as learning to read printed English, but we can also consider narrowly defined tasks like mastering the content of Lesson 20 in a certain textbook of French, or even mastering a certain grammatical construction covered in that lesson. The model presented here is intended to apply equally well to all such tasks, no matter how broad or narrow. It is required, however, that the task can be unequivocally described and that means can be found for making a valid judgment as to when the learner has accomplished the learning task - that is, has achieved the learning goal which has been set for him.

It will be seen that as many as possible of the basic concepts in the model are defined so that they can be measured in terms of time in order to capitalize on the advantages of a scale with a meaningful zero point and equal units of measurement. An effort is made to provide for a mathematical description of the degree to which a learning task is achieved. Although the model applies only to one learning task at a time, it should be possible in principle to describe the pupil's success in learning a series of tasks (e.g., all the work of the fifth grade) by summating the results of applying the model successively to each component task.

The model is admittedly oversimplified. The assumption that the work of the school can be broken down into a series of learning tasks can be called into question. In actual school practice, the various tasks to be learned are not necessarily treated as separate and distinct, and the process of teaching is often organized (whether rightly so or not) so that learning will take place "incidentally" and in the course of other activities. Nevertheless, a conceptual model requires certain simplifying assumptions, and the assumption of discrete learning tasks is a useful one to make.

The model can be regarded as applying even to those educational goals ordinarily formulated in terms of "transfer" - that is, the ability to apply in a "new" situation something learned previously. The concept of the learning task is defined to include the attainment of that degree of competence which will make "transfer" essentially as automatic as demonstration of performance in the original setting. "Transfer," correctly viewed, is a term in a metalanguage which states the conditions under which particular learnings occur or manifest themselves. Thus, when we say that "learning which occurred in situation A transfers to situation B," we are really saying that "something learned in situation A also manifested itself in situation B, there being sufficient commonality between the two situations to elicit the learned performance in both."

The model is not intended to apply, however, to those goals of the school which do not lend themselves to being considered as learning tasks. Such, for example, are those goals having to do with attitudes and dispositions. Educating a child so that he has tolerance for persons of other races or creeds, respect for parental or legal authority, or attitudes of fair play, is thought to be largely a matter of emotional conditioning or of the acquisition of values and drives. Learning tasks may indeed be involved in the cognitive support of such attitudes (as where the child learns facts about different races or creeds), but the acquisition of attitudes is postulated to follow a different paradigm from that involved in learning tasks. Perhaps the distinctions made by Skinner (6) are of use in this connection: We could say that whereas learning tasks typically involve "operants," the attitudinal goals of education typically involve "respondents."

Overview of the Model

Briefly, our model says that the learner will succeed in learning a given task to the extent that he spends the amount of time that he needs to learn the task. The terms of this statement, however, require special definition, explication, and interpretation if the statement is to be properly understood.

First, it should be understood that "spending time" means actually spending time on the act of learning. "Time" is therefore not "elapsed time" but the time during which the person is oriented to the learning task and actively engaged in learning. In common parlance, it is the time during which he is "paying attention" and "trying to learn."

Second, there are certain factors which determine how much time the learner spends actively engaged in learning.

Third, there are certain factors which determine how nuch time a person needs to spend in order to learn the task. These factors may or may not be the same as, or associated with, those which influence how much time he spends in learning.

The major part of this article is devoted to a presentation of the factors conceived as determining the times needed or actually spent in the course of a learning task and the way in which these factors interact to result in various degrees of success in learning. Four of these factors are convenient intervening variables or constructs which may, in turn, be regarded as functions of still other factors or variables; one, however, is in principle a directly manipulable and measurable factor ("opportunity").

This model of school learning should not be confused with what is ordinarily called "learning theory," that is, with the exact scientific analysis of the essential conditions of learning and the development of systematic theory about this process. Rather, the model may be thought of as a description of the "economics" of the school learning process; it takes the fact of learning for granted.

The five factors or variables in the model will be presented under two headings: (1) determinants of time needed for learning, and (2) determinants of time spent in learning.

Time Needed in Learning

Aptitude. Suppose that a randomly selected group of children is taught a certain learning task by a teacher (or teaching device) with the best possible teaching techniques. Suppose further that each child is willing to stick attentively with the learning task for the number of minutes, hours, or days required for him to learn it to the specified criterion of success, and that each child is in fact given the opportunity to do this. Common experience, as well as abundant research evidence, suggests that the amounts of time needed by the children even under these ideal conditions will differ widely. Let us think, then, of the amount of time the pupil will need to learn the task under these conditions as the primary measure of a variable which we shall call his aptitude for learning this task. In ordinary parlance, learners who need only a small amount of time are said to have high aptitude; learners who need a large amount of time are said to have low aptitude. Some learners, it may be, will never learn even under these optimal conditions; we may say that these learners would need an indefinitely large (or an infinite) amount of time to learn the task.

It will be noted that this variable is measured in the opposite direction from the usual way of measuring aptitude - the shorter the time needed for learning, the higher the aptitude.

Furthermore, it will be noted that the measure of aptitude is specific to the task under consideration. Aptitude may be regarded as a function of numerous other variables. For one thing, it may depend upon the amount of prior learning which may be relevant to the task under consideration. A learner who has already progressed far towards the mastery of a task may not need much time to complete his learning. On the other hand, aptitude may also depend upon a series of traits or characteristics of the learner which enter into a wide variety of tasks; whether these traits can be accounted for solely on the basis of generalized prior learnings, or whether they reflect genetically determined individual characteristics, is of no immediate concern here. It may be useful, however, to conceive that a learner's estimated needed time, a(t), for learning a given task, t, may be written as a mathematical function of a series of basic aptitudes, symbolized with Greek letters and subscripts, minus the amount of time, s(t), saved by virtue of prior learnings relevant to the task. Thus:

$$a(1) = f\,(a(1), a(2). . ., a(n)) - s(1)$$

The exact form of this formula would vary for different tasks. Presumably, the basic aptitudes a(1), a(2),. . ., a(n) could be measured with considerable exactitude by appropriate tests.

Ability to understand instruction. We find it useful to postulate as a variable separate from those we consider under "aptitude" the ability to understand instruction, since this variable (in contrast to pure aptitude variables) is thought of as interacting with the method of instruction in a special and interesting way. The ability to understand instruction could be measured, one would suppose, as some combination of "general intelligence" and "verbal ability;" the former of these two would come into play in instructional situations where the learner is left to infer for himself the concepts and relationships inherent in the material to be learned, rather than having them carefully spelled out for him, while the latter would come into play whenever the instruction utilized language beyond the grasp of the learner. The way in which ability to understand instruction is postulated to interact with the type of instruction will be explained after we introduce a third variable affecting time needed for learning, the quality of instruction.

Quality of instruction. One job of the teacher (or any person who prepares the materials of instruction) is to organize and present the task to be learned in such a way that the learner can learn it as rapidly and as efficiently as he is able. This means, first, that the learner must be told, in words that he can understand, what he is to learn and how he is to learn it. It means that the learner must be put into adequate sensory contact with the material to be learned (for example, one must insure that the learner will adequately see or hear the materials of instruction). It also means that the various aspects of the learning task must be presented in such an order and with such detail that, as far as possible, every step of the learning is adequately prepared for by a previous step. It may also mean that the instruction must be adapted for the special needs and characteristics of the learner, including his stage of learning. All these things may be summarized in what we call quality of instruction. This variable applies not only to the performance of a teacher but also to the characteristics of textbooks, workbooks, films, teaching-machine programs, etc.

Now, if the quality of instruction is anything less than optimal, it is possible that the learner will need more time to learn the task than he would otherwise need. Some learners will be more handicapped by poor instruction than others. The extent of this handicap is conceived to be a function of the learner's ability to understand instruction. Learners with high ability in this respect will be able to figure out for themselves what the learning task is and how they can go about learning it; they will be able to overcome the difficulties presented by poor quality of instruction by perceiving concepts and relationships in the teaching materials which will not be grasped by those with lesser ability.

For the purposes of this conceptual model, we shall say that the amount of time actually needed by a person to learn a given task satisfactorily is a function not only of aptitude (as defined previously), but also of the quality of instruction in so far as it is less than optimal. And the amount of additional time he will need is an inverse function of his ability to understand instruction.

We could, of course, apply Occam's razor and get rid of both of the two preceding variables by conceiving that a change in the quality of instruction causes an essential change in the learning task itself. In this case, we would deal only with a learner's aptitude for learning a given task, subscripted with the quality of instruction attached to it. Such a modification of our model seems undesirable, however, for one would tend to lose sight of instructional quality as one of the important manipulable variables in educational psychology.

Time Spent in Learning

Time allowed for learning ("opportunity"). It may come as a surprise to some to be told that the schools may allow less than adequate time for learning any task, but second thought will make one realize that this is very often the case. It is partly a consequence of the very large amount of material that the schools are expected to teach; the available time must somehow be distributed among many things. And it is partly a consequence of the very great variation that exists in the amounts of time that children need for learning, even under a good quality of instruction, and particularly when the instructional quality is such that many children of lower ability to understand instruction require much more time than they might otherwise need.

The school responds to differences in learning rates (for that is what differences in aptitude are) in many ways. Sometimes the policy of the school is, in effect, to ignore these differences; a certain amount of time is provided for everybody to learn, and no more. (For example, at some military academies, study time is prescribed and scheduled uniformly for all cadets.) At the opposite extreme is the case where each student is allowed to proceed exactly at his own rate; private instruction in music or foreign languages and self-instruction by teaching machine or other means are approximations to this case. The middle position is occupied by learning situations in which there is some kind of "ability grouping": Pupils are assigned to different groups, classes, or curricula on the basis of estimated learning rates.

Even when there is some constraint upon the amount of time "officially" provided for learning, teachers and instructional programs vary in the amount of time they allow for learning. Some programs present material at such a rapid pace that most students are kept under continual pressure; only the apter students can keep up with this instruction, while the others fall back or out, sometimes never to get caught up. In other programs, the instruction is paced for the benefit of the slower student. The faster student is fortunate if the teacher takes appropriate steps to "enrich" his instructional content; but this will not always happen, and it is undoubtedly the case that many fast learners lose some of their motivation for learning when they feel that their time is being wasted or when they are not kept at the edge of challenge.

Perseverance

Obviously, failure to allow enough time for learning produces incomplete learning. If a person needs two hours to learn something and is allowed only one hour, and if we assume that learning proceeds linearly with time, the degree of learning is only 50 per cent. Probably one of the most aversive things which a school can do is not to allow sufficient time for a well-motivated child to master a given learning task before the next is taken up. Children meet such frustrations by indifference or the more extreme avoidance reactions and are, in any case, handicapped in undertaking the next task.

The time the learner is willing to spend in learning ("perseverance"). The term perseverance is used here, rather than persistence, because of the somewhat perjorative connotations of the latter. Nevertheless, the concept is similar to what Paul Brandwein describes in the following passage:

> The characteristics grouped under the Predisposing Factor...include a spectrum of traits which the writer places under the head of *Persistence*. This is defined as consisting of three attitudes. (1) A marked willingness to spend time, beyond the ordinary schedule, in a given task (this includes the willingness to set one's own time schedules, to labor beyond a prescribed time, such as nine to five). (2) A willingness to withstand discomfort. This includes adjusting to shortened lunch hours or no lunch hours, working without holidays, etc. It includes withstanding fatigue and strain and working even through minor illness, such as a cold or a headache. (3) A willingness to face failure. With this comes a realization that patient work may lead to successful termination of the task at hand (*I*, pp. 9-10).

But the variable of perseverance applies not only in the case of the "gifted student" and not only in the case of long durations of effort, but also to all other learners and also to learning tasks which require only short times for mastery. That is, in the general case, a learner who (in view of his aptitude, the quality of the instruction, and his ability to understand the instruction) needs a certain amount of time to learn a task may or may not be willing to persevere for that amount of time in trying to learn. It is not a matter of his predicting how long he will be willing to learn: we simply postulate that there is a certain time over and above which he will not continue active learning of a task, and this time may lie anywhere on the scale from zero to infinity. The learner may not be motivated to learn at all, or he may regard the task as something too difficult for him to learn,; in either case, he may spend no time at all in trying to learn. He may start to learn and later become distracted or bored, or he may lose confidence in his ability. He may go far toward mastery and then overestimate his achievement, thus prematurely terminating his efforts to learn. He may, of course, be so highly motivated that he would be willing to spend more time than he needs in order to reach a specified criterion of mastery. Nevertheless, for the purposes of our conceptual model, it will be assumed that the learner will never actually spend more time than he needs to master the task as defined, that is, that he will stop learning as soon as he has mastered the learning task. (In this way we avoid, for the present, the necessity of incorporating a concept of "overlearning" in the model.)

This variable, which may be called *per-*

severance-in-learning-to-criterion, is thus measured in terms of time, and if it is not sufficiently great to allow the learner to attain mastery, it operates in our conceptual model to reduce the degree of learning. Assume, as before, that learning proceeds as a linear function of time. Then if a child needs two hours to learn something, is allowed one hour, but will persevere only thirty minutes, the degree of learning is only 25 per cent. Perseverance-in-learning is measured only in terms of the amount of time the child is actively engaged in learning; a child who is actively engaged in learning for various periods totaling only thirty minutes during an hour is presumably not paying attention to learning for the other thirty minutes, and this time is not counted.

Perseverance-in-learning is itself a function of many other variables which will not be separately treated in this conceptual model. It is a function partly of what is ordinarily called "motivation" or desire to learn. But there are many reasons for desiring to learn a given thing: To please the teacher, to please one's parents or friends, to get good grades or other external rewards, to achieve self-confidence in one's learning ability, to feed one's self-esteem, to avoid disapproval - all these can operate in place of or in addition to any incentives for learning which may derive from the intrinsic interest or perceived utility of the thing being learned. And there are probably just as many reasons which one may adopt (consciously or unconsciously) for not learning: to avoid the responsibilities which learning brings, to avoid the exertion of learning, to behave consistently with one's image of oneself as a non-learner, or to avoid wasting time on learning tasks of no perceived importance.

Perseverance-in-learning may also be a function of what are ordinarily called emotional variables. One may desire to learn but be unable to endure frustrations caused by difficulties in the learning task or distractions from external circumstances. It may also interact with the quality of instruction; poor quality of instruction may reduce perseverance-in-learning even beyond the toll it takes in wasted minutes or even weeks.

The Complete Model

It will be noticed that the model involves five elements - three residing in the individual and two stemming from external conditions. Factors in the individual are (1) aptitude - the amount of time needed to learn the task under optimal instructional conditions, (2) ability to understand instruction, and (3) perseverance - the amount of time the learner is willing to engage actively in learning. Factors in external conditions are (4) opportunity - time allowed for learning, and (5) the quality of instruction - a measure of the degree to which instruction is presented so that it will not require additional time for mastery beyond that required in view of aptitude.

Three of the factors are expressed purely in terms of time. If ability to understand instruction corresponds to a combination of general and verbal intelligence, it can be assessed in relative terms by currently available measuring devices. The most elusive quantity in this model is that called quality of instruction, but both it and the ability to understand instruction are interconnected with temporally measurable variables in such a way that by appropriate experimental manipulations, they could eventually be indexed in terms of time. Temporarily, let us put quality of instruction on a scale from 0 (poor) to I (optimal), and ability to understand instruction on a standard score scale with mean = 0 and standard deviation = 1.

The five factors can be worked into a tentative formula which expresses the degree of learning, for the ith individual and nth task, as function of the ratio of the amount of time the learner actually spends on the learning task to the total amount he needs. Thus:

The numerator of this fraction will be equal to the smallest of the following three quantities: (1) opportunity - the time allowed for learning, (2) perseverance - the amount of time the learner is willing to engage actively in learning, and (3) aptitude - the amount of time needed to learn, increased by whatever amount necessary in view of poor quality of instruction and lack of ability to understand less than optimal instruction. This last quantity (time needed to learn after adjustment for quality of instruction and ability to understand instruction) is also the denominator of the fraction. It is not necessary or worthwhile here, however, to pursue the detailed mathematical formulation, which has been given elsewhere (3).

As an illustration of the usefulness of this model in clarifying other educational concepts, let us see how it provides a framework for interpreting the notion of "underachievement" as criticized by Henry Dyer (4). While we are at it, let us also look at the notion of "overachievement." It is our contention that these terms are useful and salvageable if properly defined.

Underachievement and overachievement, like underweight and overweight, are ordinarily taken with reference to some norm or baseline of expectation. The underachiever does poorer than we expect him to, and the overachiever does better than we ecpect him to. The issue is this: Upon what do we base our expectation? The approved manner of doing this is to make predictions from those tests or other measurements which in fact yield the best predictions of suceess, and statistical theory tells us how to make best use of these predictors (i.e., by making our predictions along a regression line). There is, however a paradox here. Suppose our predictions were perfect: Then there would be no "underachievers" and no "overachievers." An unlikely eventuality to be sure! Nevertheless, our intuitive rejection of the case of perfect prediction lends credence to the following analysis of what we mean by "underachievement": Underachievement is a situation in which there is a discrepancy between actual achievement and that expected on the basis of a certain kind of evidence-evidence concerning the "capacity" or "aptitude" of the individual to achieve in a particular context. Such evidence is recognized as being quite distinct from evidence concerning other factors in achievement, e.g., "motivation," "opportunity for learning," etc., and these latter factors would not figure in forming our expectations. Instead, we would hope to gather as much evidence as possible concerning the "capacity" or "aptitude" of the individual, defined as his learning rate when all other factors are optimal.

Achievement and Expectancy

With reference to the conceptual model presented earlier, our expectation of an individual's achievement in a given learning task would in the strictest sense be that which he would attain when he spends all the time he needs - that is, when the ratio of the time spent to the time needed is unity. Anything less than this is, to some degree, underachievement. From this point of view, all learners are underachievers unless they are super-human beings in an ideal world. Perseverance sometimes flags; the quality of instruction is seldom optimal, and time allowed for learning is not always sufficient.

Let us, therefore, strike some sort of average for perseverance, instructional quality and opportunity for learning. Our expectation of the degree of learning will be somewhat less than unity because, on the average, individuals will spend less time in learning than they need. And we may gauge underachievement and overachievement with reference to this expectation. In effect, this is what we do by the customary regression techniques based on aptitude measures, although in a less precise way than might be done if we were able to measure each of the components of achievement as stated by the model. In the framework of the model, however, underachievement is now see to be a state of affairs which results whenever perseverance is less than some "reasonable value," whenever the quality of instruction is poor, whenever time allowed for learning has not been sufficient, or whenever some combination of these conditions has occurred. "Overachievement," contrariwise, may occur when there is an especially favorable combination attendant events: high perseverance, instruction of high quality, or ample opportunity for learning.

We have a feeling about the relative amenability of different factors in achievement to manipulation or treatment: "Aptitude" is regarded as relatively resistant to change, whereas it is the hope of the psychologist that he can readily intevene to modify "perseverance," "quality of instruction," or "opportunity for learning." To some extent, this feeling is justified not only by logic but also by research findings - by the research on the apparent constancy of the IQ, on the effect of various instructional variables, etc. On the other hand, if aptitude is largely a matter of prior learnings, it may be more modifiable than we think, whereas, conversely, some kinds of clinical findings suggest that motivational characteristics of the individual may be much harder to change than on might think. These consideration, however, need not detract from the basic utility of the concepts of underachievement and overachievement. The concept of "underachievement" does not automatically imply the possiblility of remediation any more than the concept of illness does. Some patients never get well, and some underachievers remain underachievers.

Babies and Bathwater

Henry Dyer (4) has drawn attention to possible dangers in the concept of underachievement - for example, the dangers of making predictions from unreliable or invalid predictors, of assuming that ability is innate or fixed, of making unwarranted inferences from school marks, and of overlooking determinants of school performance which are external to the pupil. Nevertheless, in suggesting that we kill the notion of underachievement, it would seem that he wants to throw out the proverbial baby with the bathwater. The concepts of underachievement and of overachievement are meaningful from both a statistical and a clinical point of view, as shown by the many fruitful studies of "underachieving" groups of students (e.g., 5). Careful attention to the elements of the conceptual model presented here will afford a safeguard against misuse of the concepts: Aptitude must be estimated by relevant and reliable measures (in actuality, all of them measures of past perforance); the degree of learning must be accurately appraised, and the possible role of instructional variable which we have called perseverance must validly assessed; the most direct evidence concerning it, our model would suggest, would come from observations of the amount of time the pupil actively engages in learning.

Before leaving this topic, let us consider another way in which this term "overachievement" is sometimes used. When a person is designated as an overachiever, it is often implied that his achievements derive more from his perseverance than from his aptitude or his intelligence. In terms of our model, this can occur when the learning task can be broken down into a series of subtasks of varying difficulty with difficulty roughly gauged in terms of average learning time. Because of his great perseverance, the overachiever masters to a criterion more of the easy tasks - tasks which are within the compass of his aptitude - than the student of average perseverance. While he may fail to learn some of the more difficult tasks, the net result may be a high score on an achievement test a score considerably higher than predicted from aptitude measures. This concept of overachievement is distinctly different from the concept of overachievement suggested previously; responsible users of the term must clearly state which of these meanings they intend.

Future Research

Our conceptual model could lead, it would seem, to almost endless possibilities for research. It should provoke renewed effort to develop measures of each of the basic variables included in the model. The measurement of aptitudes is a fairly well advanced art, although the exact ways in which these aptitudes are relevant to school learning tasks remain to be worked out. The same remark may be made about the measurement of ability to understand instruction. But measurements of perseverance and of instructional quality are practically nonexistent. It should be intriguing to attempt to provide a general way of measuring opportunity to learn, that is, the actual time available to individual students to learn in view of the pacing of instruction; for it is our hypothesis that variations in the pacing of instruction have remained largely unrecognized in pedagogical discussions.

Research is also needed on the interaction of the several variables in the model. Is the model correctly put together? To what extent are the variables interdependent? For example, how does instructional quality affect perseverance? In what way is the degree of learning a function of the ratio of the amount of time spent in learning to the amount of time needed? Are we correct in postulating an interaction between instructional quality and ability to understand instruction such that pupils low in the latter ability suffer most from poor instructional quality?

One of the most exciting possibilities suggested by the model is that of being able to state parameters for different types of learning by learners of varying characteristics under stated instructional conditions. Perhaps ultimately such parameters could be tied back to the data of pure learning theory. One of the bolder hypotheses implicit in the model is that the degree of learning, other things being equal, is a simple function of the amount of time during which the pupil engages actively in learning. Psychologists have paid little attention to this variable of pure time in human learning. A recent experiment by Bugelski (2) is one of the few to consider time factors in the field of paired associate learning; and interestingly enough, it supports the hypothesis that more parsimonious descriptions of learning may be obtained by use of time as a variable rather than, say, number of trials.

What is important to emphasize is that this conceptual model probably contains, at least at a superordinate level, every element required to account for an individual's success or failure in school learning (at least in the learning tasks to which the model applies). The explication and refinement of these factors and the exploration of their interactions constitute a major tasks of educational psychology. Its other major task is to account for those types of school learning (e.g., attitudinal and emotional conditioning) to which the present model is not intended to apply and for which a separate model might well be constructed.

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Exercise 1.3

Carroll's Model of School Learning contains five elements. Explain each of these elements in your own words.

1. Opportunity to Learn
2. Perseverance
3. Aptitude
4. Ability to Understand Instruction
5. Quality of Instruction

Exercise 1.4

Write Carroll's formula for degree of learning.

MASTERY LEARNING IN THE CITY COLLEGES: THE FIRST DECADE

Over the past ten years, the Mastery Learning program at the City Colleges of Chicago has grown from a group of four instructors at one of our colleges to 250 faculty members system-wide.

It has grown this much because it has been shown to produce results in terms of improved student performance and academic self-concept, and decreased attrition.

The City Colleges of Chicago (CCC) is a multi-campus institution serving some 124,000 full and part-time students. Most of our students (59%) are female and, at a median age of 26.2 years, they are frequently managing a job and a home as well as school. In addition, many of our students come to the City Colleges poorly prepared for even the beginning college courses.

Given these conditions, many CCC faculty and administrators saw the need for new methods of instruction which would adapt themselves to the individual needs of our students within the traditional classroom framework. When Bloom published his "Learning for Mastery" (reprinted earlier in this unit), it seemed to meet these needs, and some instructors throughout the system began using its techniques in 1969.

In 1972, with a grant from HEW, it became a unified effort.

Olive-Harvey

The first four instructors to use Mastery Learning officially in the City Colleges — two in biology and two in mathematics — were all at Olive-Harvey College. Emmett Jones was released from his classroom responsibilities to guide them in the development of mastery materials and monitor the implementation of their Mastery Learning classes. During this period, 1972-1975, when Mastery Learning was used exclusively at Olive-Harvey, 71% of the mastery students achieved grades of A or B, while only 49% of the students in control classes taught by the same teacher did so. Furthermore, only 11% of the mastery students received D's or F's, while 17% of the control students did.

Expansion

Encouraged by these results, all of the CCC colleges began using Mastery Learning. (All of the results listed below are based on figures from the seven campuses in the traditional community college mold.)

In the spring of 1976, Dr. Benjamin Bloom held a seminar on Mastery Learning techniques for approximately 80 members of the CCC faculty. The following summer, 35 CCC instructors attended a similar conference, in which lectures on Mastery Learning were followed by workshops developing classroom materials.

Since Mastery Learning was being implemented at seven colleges, Mastery Learning coordinators were assigned at each campus. These are experienced Mastery Learning professionals who monitor the programs at their colleges. They act as liaisons between the Director and the teachers on the local campus, promote the use of Mastery Learning, and recruit mastery teachers. They also handle such administrative details as distributing supplies, making sure that teachers receive the credits they've earned, and collecting data for our research into the effectiveness of Mastery Learning.

While we had them, the coordinators also oversaw the work of the Mastery Learning managers. The managers, who were hired in 1977-78 through CETA funds, helped the teachers cope with the administrative detail of running a mastery class. The managers also tutored students individually and worked with students to improve their attitude toward learning and their academic self-concept.

By 1976, Mastery Learning was being used by 37 instructors in 77 classes in seven colleges in the system. This meant that, even with the coordinators, supervision was much looser than it had been when there was only a handful of teachers at one college. Even at Olive-Harvey many of the teachers, by now thoroughly familiar with Mastery Learning techniques, were modifying the techniques to suit their own teaching approaches.

For our evaluations during this period, we continued to pair mastery and non-mastery classes, but they were matched by course number (English 101Q) rather than by teacher. Again, the students in the mastery classes received higher grades than students in non-mastery classes. During school year 1976-77, 43% of the students in mastery classes achieved grades of A or B, while only 35% of the students in non-mastery classes did. In 1977-78, the comparable figures were 46% and 43%; in 1978-79, they were 40.2% and 33.8%. Students in mastery classes also received fewer D's and F's. Only 28% of the students of the students in mastery classes in 1976-77 scored that low, while 35% of the non-mastery students did. In 1977-78, 28% of both mastery and non-mastery students received D's and F's, but by the next year the mastery students again scored fewer D's and F's: 25% vs. 29.5%.

The Current Period

Dr Rocco Caponigri became director in the summer of 1979, and shortly thereafter the Project formally became part of a unit later known as the Center for the Improvement of Teaching and Learning at Chicago City-Wide College. This past year the Project, as part of CITL, was transferred to the central administration.

Many of the activities begun under Jones have been continued and expanded, and new ones have been added.

Workshops on Mastery Learning are still held for CCC faculty. To encourage them to attend and to try Mastery Learning in their classroom, the CCC administration grants faculty members credit toward lane promotion. Workshop participants are required to develop a set of Mastery Learning materials and implement their Mastery Learning strategy in the classroom in at least one course for one semester.

In order to make implementation of Mastery Learning simpler for the CCC faculty, the Project staff assembled this Mastery Learning Workbook, which has been updated each year.

The Project also provides supplies for Mastery Learning teachers, publishes a newsletter, and maintains a Mastery Learning library (a compilation of Mastery Learning materials developed by our teachers for use in City Colleges classes).

In addition, since 1980, the City Colleges have hosted annual Mastery Learning conferences for educators from across the country. These conferences have featured presentations from some of the leading authorities on Mastery Learning, as well as workshops on creating mastery materials and administrative and research aspects of Mastery Learning.

Summary

In the past decade, the Mastery Learning Project at CCC has grown to more than 60 times its original size and has been institutionalized system-wide. It is currently one of the largest such projects at the community college level in the country.

The project is currently working on a way of measuring which teachers are most effective, and what makes them effective. We are developing mastery materials for basic courses in reading and math. We are also exploring the possibility of setting up a teaching internship in Mastery Learning with some of the local universities.

The Mastery Learning Project at CCC has grown this large because it works. It does improve student performance and reduce attrition. What we want to do now is to increase both the effectiveness of the method and the number of teachers using it.

Exercise 1.5A

If you have used Mastery Learning in a course, answer the following questions. If not, proceed to Exercise 1.5 B, which follows. This will help you meet objective 1.5.

Course(s) you used Mastery Learning in ______________________________

Date(s)______________________________________

1. What effects did Mastery Learning techniques have on student achievement? Cite specific instances.

2. How did your students react to the use of Mastery Learning techniques in their course? Give specific examples.

3. Which component(s) of Mastery Learning seem(s) to contribute most to the effectiveness of the techniques of your course? Why?

4. Did you have any problems in implementing Mastery Learning techniques in your course? If so, how did you overcome them?

5. What advice would you give to a teacher who is planning on using Mastery Learning for the first time?

6. In future courses, how do you plan to further develop Mastery Learning techniques?

Exercise 1.5 B

If you have not implemented Mastery Learning in a course, answer the following questions.

Course in which you plan to use Mastery Learning________________________________

Date____

1. When and how did you become interested in Mastery Learning?

2. What cognitive outcomes would you want to see in your students in order to deem Mastery Learning a sucess?

3. What affective outcomes would you want to see in your students in order to consider Mastery Learning a success.

4. What other outcomes would you like to see in your students as a result of using Mastery Learning?

TOPICAL OUTLINES

When you begin to develop a Mastery Learning course, the first thing to do is to develop a topical outline for your specific subject area. You may find the table of contents and the index in textbooks or other instructional materials useful as sources to help you develop your outline. Each topic or sub-topic should be a subject matter element and should be listed in the order in which it will be taught. This outline should reflect your own teaching style, the characteristics of the subject you teach, and your judgment of the pedagogical relationship among various tasks.

There are a variety of ways in which you can set up these outlines. Some are very broad, such as this one from Yvonne Cogburn's English 103 course.

Unit One - The Composition
Module 1 - Giving Directions
Areas of Study

1.	The Introduction	
2.	Topic Sentence	pages 6-7
3.	Paragraph development	pages 11-13
4.	Concluding paragraph	pages 14-16

or this from Elise Gorum's Reading 125 course.

1. Study Habits and Textbook Reading
A. Study Skills and Resources
B. Devloping a Daily Activity and Study Schedule
C. Textbook Reading Methods
D. OARWET Textbook Reading Method

Others prefer to take a much more detailed approach. The following examples, from Rosalind Cox's Math 103/111 course and Pat Armstrong's Business 100 course, show topical outlines which are organized around what each instructor intends to accomplish in each class period.

Math 103/111

WEEK	MEETING	HOMEWORK	OBJECTIVE	DEGREE OF COMPETENCY
1	1	Read pp. 27-35	1.0 INTRODUCTION TO NATURAL NUMBERS	
			1.1 Overview of Mastery Learning	
			1.2 Identidy Natural Numbers	80%
			1.3 Recall place values of a natural number	100%
			1.4 Define x^n, base, exponents (power)	100

Business 100

1. Introduction to Mastery Learning
   A. Introduction of Students
   B. Introduction of Assistant
   C. Orientation

      Homework:
      1. Read Chapter 1 (12 pages)
      2. Concentrate on pages 3-8.
      3. Workbook, pages 2-3

As you can see, these outlines may be set up in a variety of formats and may be more or less detailed. You will have to find the style which suits your subject and your teaching style best.

We recommend that you construct outlines which describe the topics to be covered in a single class period. You may also wish to list homework assignments and degrees of competency for topics to be covered in each class period. It has been our experience that those topical outlines which are stated in explicit terms are more beneficial to teachers and students than those stated in broader terms.

Exercise 1.6

Develop a topical outline for your Mastery Learning course. We suggest that you make these outlines as explicit as possible, and that you include homework assignments and a schedule of quizzes and examinations. This will fulfill Objective 1.6.

Formative - Unit I

TRUE OR FALSE

1. T____F____ In Carroll's "A Model of School Learning," he develops a model of the factors affecting success in school learning and the way they interact.

2. T____F____ Carroll makes a strong argument that his "model" is not an oversimplification.

3. T____F____ Carroll's model can also be applied to those goals and objectives that have to do with attitudes and dispositions.

4. T____F____ One of the basic postulates of Caroll's model is that aptitude is (directly or inversely) proportional to learning rate.

MULTIPLE CHOICE

5. In Carroll's model the basic concepts are defined so that they can be measured in

A. Units of Difficulty
B. Time
C. Distance
D. Freudian Terms
E. None of These

MATCHING

A. Aptitude
B. Perseverance
C. The Ability to Understand Instruction
D. Quality of Instruction
E. Opportunity to Learn

6. ___The degree to which the presentation, explanation and ordering of the elements of the task to be learned approach the optimum for a given learner.

7. ___The ability of the learner to understand the nature of the task he is to learn and/or the procedures he is to follow in the learning of the task.

8. ___The amount of time required by the learner to attain mastery of a learning task.

9. ___The time allowed by the teacher or school for the student to learn a task.

10.___The amount of time the learner will engage in active learning efforts.

MUTIPLE CHOICE

11.___In Bloom's Mastery Learning, the achievement criteria are:

A. Normative
B. Absolute
C. Relative
D. Flexible
E. None of the above

TRUE OR FALSE

12.___When properly designed, Mastery Learning promotes competition among classmates.

MATCHING

Match these terms with their meaning as defined in Bloom's Mastery Learning.

A. Objectives
B. Formative Evaluations
C. Correctives
D. Retakes
E. Summative Evaluations

13.___Used to give the students a second chance to demonstrate that they have achieved mastery.

14.___Used for grading.

15.___Detailed statement specifing the knowledge and skills to be achieved.

16.___Usually diagnostic progress quizzes.

17.___Assignments specific to each student.

ANSWERS

1. Exercise 1.2

1. Why does Bloom object to using the normal curve in grading students?

   The grades are relative; a student who gets a C in one class may actually have learned more than a student who receives an A in another class. Furthermore, getting consistently bad grades on the curve may give a student an undeserved bad, academic self-image.

2. What are the variables for Mastery Learning?

   These variables are:
   1. Aptitude for particular kinds of learning
   2. Quality of instruction
   3. Ability to understand instruction
   4. Perseverance
   5. Time allowed for learning

3. How can instruction be varied to meet the needs of the individual?

   Students can meet in smaller groups. A tutor may be used to approach the material from a different point of view. A teacher can use an alternative textbook, audiovisual materials, and/or academic games.

4. What are absolute standards?

   Absolute standards are objective ways of setting criteria for various grade levels, rather than ranking students by their performance relative to the other members of the group.

5. How does Mastery Learning change a student's attitude toward learning?

   Mastery Learning helps the student improve his self-image by enabling him to achieve mastery of portions of the subject and receive public recognition for his achievement. This will lend him on to further mastery and to a more positive attitude toward toward learning in general.

II Formative Quiz

1. True
2. False
3. False
4. True
5. B
6. D
7. C
8. A
9. E
10. B
11. B
12. False
13. D
14. E
15. A
16. B
17. C

UNIT II

ANALYZING LEARNING UNITS
AND
ENTRY BEHAVIORS

OVERVIEW FOR UNIT II

In this unit we will study cognitive and affective entry characteristics and how they affect the student's performance in a new learning situation.

A student brings with him his whole learning history, and his perception of that history affects how well he will do in the new learning situation.

Each student needs certain cognitive entry behaviors -- types of knowledge, skills and competencies — in order to successfully complete a learning task. In the selection entitled "Cognitive Entry Behaviors," Bloom describes how these behaviors affect learning and how a teacher can compensate for a student's lack of the required entry behaviors.

The student also brings with him attitudes toward the subject, toward school and toward himself as a learner. These attitudes, called affective entry characteristics, account for up to one-fourth of the variation in cognitive achievement. The unit contains a summary of Bloom's discussion of affective entry characteristics.

In preparation for your Mastery Learning course, you will be asked to select a textbook and divide the course into learning units.

OBJECTIVES FOR UNIT II

2.1 Select a textbook for your Mastery Learning course.
2.2 Divide your topical outline into learning units.
2.3 Define what Bloom means by cognitive entry behaviors.
2.4 Distinguish between positive and negative affective entry characteristics.

SELECTING A TEXTBOOK

In your Mastery Learning course, you will have the responsibility of selecting a textbook and other instructional materials. To help you with the selection of instructional materials, the following criteria may serve as a guide.

I. Content
   1. language adult in tone, and at the appropriate reading level
   2. one concept presented at a time with clear explanation and examples
   3. subject matter and learning activities of interest to adults
   4. practical subject matter and learning activities presented whenever appropriate to subject
   5. use of illustrative and visual materials whenever possible to clarify concepts
   6. a variety of reinforcement activities presented
   7. practice activities provide for individual differences in learning style and needs
   8. content recognizes and appreciates many cultural and social values
   9. study aids (glossaries, definitions, illustrations, diagrams, examples, maps, etc.) included when appropriate to subject matter

II. Organization
   1. logical sequence of skills and concepts
   2. objectives stated: clear, practical, attainable
   3. provides adequate reinforcement exercises
   4. provides clearly stated directions
   5. activites, whenever possible, permit the student to process independently
   6. provides versatility in instructional use (i.e.: individual, small group, whole class)

III. Assessment or Evaluation (both qualitative and quantitative)
   1. clearly stated reasonable standards for assessment
   2. permits the student to evaluate his own progress
   3. includes pre- and post-tests of skills
   4. answers include explanations both for correct and incorrect answers, with page references to the concept needed

IV. Format
   1. a teacher's manual or edition is available, which includes readability levels of the materials
   2. the readability levels are not identified in the student edition
   3. readability levels kept constant or increase slowly as book progresses
   4. supplementary materials suggested
   5. large, easy to read print
   6. material reusable or includes means for reproducing expendable materials
   7. cost reasonable for use

SOURCE: Donna D. Amstutz, ABE Sourcebook, De Kalb, Northern Illinois University, 1978, pp. 23-24.

Exercise 2.1

A. Review the textbook selection process in your department. Identify the steps you would take to select an appropiate textbook for your Mastery Learning course. Remember that these may not be the same as the steps your department currently takes.
B. Consult textbook representatives and publishers to learn what the popular texts are in your field and compare them to the ones you normally use.
C. Name the textbook(s) you will be using for your Mastery Learning course.

ANALYSIS OF LEARNING UNITS

In the last unit you outlined the entire course you plan to teach. Now you will divide this course into units.

Dividing the course into units allows the teacher and students to focus on one portion of the course at a time. As each unit is finished, a formative quiz is administered to the students to determine if each of them has achieved mastery of that unit. Dividing the course into units also makes it easier to review the course to determine which parts were successful and which need improvement.

How large should a unit be? In Human Characteristics and School Learning, Bloom suggests that it should take between one and ten hours for a student to learn. Considered this way, a unit can contain "a variety of ideas, procedures, or behaviors to be learned over a short period of time." The following selection gives a more thorough explanation.

THE UNIT OF LEARNING

Within a course or education program there are parts which have a separable existence such that they can, at least for analytic purposes, be considered in relative isolation from other parts. While these parts may be interrelated in various ways so that the learning of one part has consequences for the learning of others, it is still possible to consider each part separately.

The nature of the unit may vary for different purposes. In curriculum construction, it may be desirable to regard the unit as a single lesson or learning session. However, for the practical purposes of instruction and learning, it appears that a useful unit would be something larger than the single session. A unit of learning could be the content covered in a chapter of a textbook or the material covered in one to two weeks of instruction. The delineation of the unit may be arbitrary; ideally it should be determined by natural breaks in the subject matter. A unit of learning consists of specific subject matter taught over a given period of time.

It is possible for the curriculum maker to construct a unit by beginning with a set of specifications in which he outlines in some detail the content to be included as well as the student behaviors or objectives to be achieved in relation to this content. Ideally the curriculum maker may also determine the standards to be met in the attainment of the specifications. Given the set of specifications, teachers attempt to create the material and set the learning experiences which will enable students to develop in the ways specified.

CONTENT

The first step is to determine what new content or subject matter will be introduced in the new unit. What are the new terms, facts, relations, and procedures to be defined, illustrated, or otherwise presented in the learning material?

We find that the good textbook are relatively clear in signaling the new content to be developed in a particular chapter. In either the textbook or the teacher's guide, the new material is indicated by changes in print or color, comments in the margin, the summary at the end of the chapter, or the index.

BEHAVIORS

A second type of analysis is undertaken to determine the student behaviors or learning outcomes related to each new element of content. That is, given a new idea, relation, statement of fact or other information, what is the student expected to learn? What is the student expected to remember? What is he expected to be able to do with the specific subject matter introduced in the learning unit?

We have found it useful to classify the new elements of subject matter or content according to some of the categories in the Taxonomy of Educational Objectives, Handbook 1, Cognitive Domain (Bloom, 1956). These classifications define a hierarchy of behavior that relate to the difficulty and complexity levels of the learning process. Bloom's and Gagne's taxonomies will be discussed in more detail in the next unit, but the overview below will show the main levels.

Knowledge of Terms The "terms" are the specific vocabulary of a subject that the student is to learn. He may be expected to define the term, recognize illustrations of it, determine when the term is used correctly or incorrectly, or recognize synonyms. This category represents the lowest or simplest behavior level in the Taxonomy.

Knowledge of Facts "Facts" are the specific types of information which the student is expected to remember. They may include dates, names of persons or events, and descriptions. The student may be expected to distinguish between accurate and inaccurate statements of the fact or to remember the correct fact when asked about it in a direct manner.

Knowledge of Rules and Principles This classification entails recall of the major ideas, schemes, and patterns by which the phenomena and ideas in a subject area are organized. Rules and principles bring together a large number of facts or describe the interrelationships among many specifics in such a way that the student can organize a large body of information in a harmonious manner. The student is expected to know the rule or principle, to remember the illustrations of it used in the instruction, to recall situations in which it is applicable, and to remember the conditions under which it is or is not applicable. Rules and principles are likely to be more abstract and more difficult to learn than specific terms and facts. However, it is important to recognize that this category deals only with the recollection of the rules and principles and not with their application.

Skill In Using Processes and Procedures This category is not included in the Taxonomy. We found, after inspecting a number of courses and especially some of the newer curriculum materials, that students are frequently expected to be able to use certain procedures and operations accurately and rapidly. Quite frequently these are particular steps in a process which the student learns in the appropriate sequence. It is sometimes possible for the student to learn a process before he has a name or rule to identify it — for example, he may be able to speak correctly before he has grammatical rules, or to take the square root of a number by following correct steps before he has a rule or principle which "explains" the operation. In this category the emphasis is on the student's being able to use the process or procedure accurately. That is, the student can do the steps in the procedure in the correct order, and he can get the correct result with a minimum of awkward or extraneous activity.

Ability To Make Translations This category involves the transformation of a term, fact, rule or principle, or process or procedure from one form to another. In translation the student can put the idea in his own words; he can take a pheonomenon or event presented in one mode or form and represent it by an equivalent form or mode. For example, the representation may move from a verbal to a symbolic form, from a concrete to a more abstract form, or from a general to a more specific illustration, and vice versa. The student will be able to use new illustrations of a term, fact, rule, or other matter, and determine when a new illustration is an appropriate or inappropriate one for it. In general, translation is being employed when the student puts an idea in his own words or uses relatively new examples of what he has already learned.

Ability To Make Applications "Application" is the use of rules and principles to solve problems presented in situations which are new or infamiliar to the student. The primary behavior required at the application level is the use of a rule or principle learned in one context to solve a problem presented in a new context. If a problem is one the student has encountered many times previously except that new data are substituted, the behavior to be performed can be classified as translation rather than application. It is difficult to identify examples which represent true application without some knowledge of the learning materials or context within which the student originally encountered the relevant rules and principles. In application the student must recognize the essentials of the problem; determine the rules, principles, generalizations, and so forth which are relevant; and then use these ideas to solve a problem which is different from those previously encountered in the instruction or instructional materials. This is the most complex of the categories in that it depends on some of the previous classifications but requires the student to apply the ideas in new situations or problems.

ADAPTED FROM:

Bloom, Hastings and Madaus. Handbook on Formative and Summative Evaluation of Student Learning. New York. McGraw-Hill. 1971. pp. 118-120.

Exercise 2.2

Divide your topical outline into six to nine learning units. This will fulfill Objective 2.2.

COGNITIVE ENTRY BEHAVIORS

Every group of students shows some variation in the amount of learning they actually achieve on any given learning task. In trying to explain why, we often place great emphasis on the learner's history. We assume that if all the students had the necessary prerequisites for a given learning task, the variation in the amount of time students take to learn the task and in the degree of learning would be greatly reduced.

These prerequisite types of knowledge, skills, and competencies which are necessary for the learning of a new learning task are called cognitive entry behaviors. These behaviors may be either general prerequisites (e.g., reading skill) or specific prerequisites for a given learning task.

Much of the variation in the learning of any particular given learning task is attributable to variations in the relevant knowledge, skills, and achievement that the students had at the beginning of the class.

1) If all the students lack the necessary prerequisites, it should be impossible for them to learn the task to any acceptable criterion no matter how high the quality of instruction or how much effort the teacher and students put into that learning task.
2) If all the students do possess the necessary prerequisites, they should be able to learn the task if they participate in the mastery process and if the quality of instruction is high. If these conditions are met, the students should all be able to learn the new task with little or no variation in the level of achievement.
3) If the learners vary widely in their possession of the necessary cognitive entry behavior, there will be a great variation in the level of achievement on the new task and in the time that is needed to reach an acceptable criterion of achievement.

Another fact affecting student learning is the student's ability to remember and use prior learning when and where they are required to learn a specific new task.

Within each unit, the learning tasks are arranged in a particular order. Sometimes this order is non-sequential, and the mastery of Unit I is not a necessary prerequisite for the mastery of Unit II. Sometimes, however, the arrangement is sequential, and mastery of the first task is a prerequisite for mastery of the second task which, in turn, is a prerequisite for mastery of the third task.

When learning tasks are arranged in a truly sequential order, the most critical tasks are likely to be the first ones in the sequence. If these early tasks are not learned adequately, the student is likely to have trouble with all the later tasks. Uncorrected difficulties on the first task are likely to be compounded by uncorrected difficulties on the second task, and by even more difficulties on the third.

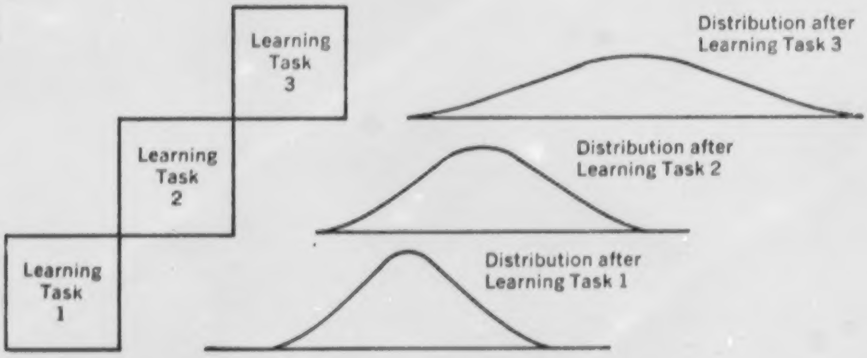

Learning Task 3
Distribution after Learning Task 3
Learning Task 2
Distribution after Learning Task 2
Learning Task 1
Distribution after Learning Task 1

Fig. 2.1

In contrast, if the students learn all or most of the essential part of the first task before moving on to the second task, and if their learning of the second task is adequate, there should be equal or decreasing variation in achievement over each subsequent learning task.

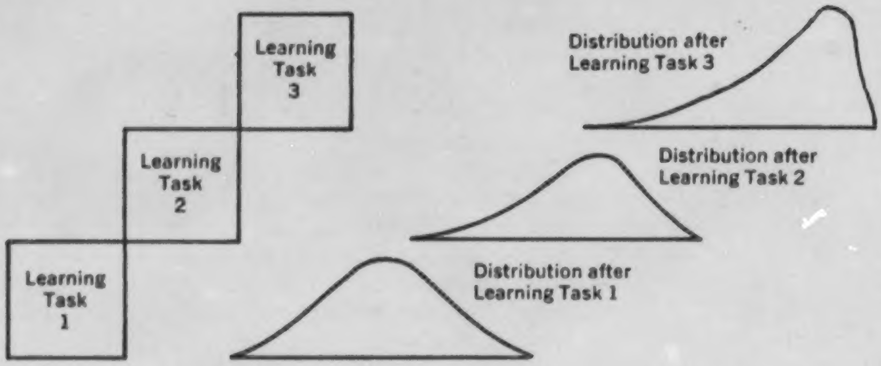

Learning Task 3
Distribution after Learning Task 3
Learning Task 2
Distribution after Learning Task 2
Learning Task 1
Distribution after Learning Task 1

Fig. 2.2

There are a number of ways in which a teacher can compensate for a student's lack of the necessary cognitive entry behaviors. The most frequent method used to be to advise students not to take a particular course. A teacher might also furnish instruction on the missing entry behaviors for those students who lack them, or review the necessary prerequisites for the whole class before beginning the learning task itself.

ADAPTED FROM:

Bloom, Benjamin S. Human Characteristics and School Learning. New York. McGraw-Hill. 1976. Chapter Three. "Cognitive Entry Behaviors".

Exercise 2.3

Define what Bloom means by cognitive entry behaviors. This will fulfill Objective 2.3.

AFFECTIVE ENTRY CHARACTERISTICS

Students vary in the attitudes they bring to a given learning task, and these attitudes in turn influence how well the students will perform. Some will approach it with evident interest and desire to learn; some will regard it as a duty which they will fulfill, but with little enthusiasm; still others will approach it with dread, expecting only failure and negative judgments from parents, teachers, and peers.

Just as different students may approach the same learning task with different attitudes, the same student may approach different learning tasks with different attitudes. A student may approach an elective more eagerly than a required course, and a class he chooses outside the regular school system more eagerly than an elective school subject.

These attitudes are called affective entry characteristics. They may be divided into three main areas:

1) Subject-related affect,
2) School-related affect, and
3) Academic self-concept.

Subject-Related Affect. An individual tends to like those activities he believes he has done or can do successfully. His attitude is affected not as much by how well he actually did in the past as by how well he perceives he did. It is also affected by his perception of the relation between the present task and some larger set of future goals, purposes, or objectives he has in mind.

School-Related Affect. A student's attitude toward a given learning task is also affected by his attitude toward school in general. His perception of success or failure in school learning tasks is related to approval or disapproval from teachers, parents, and peers. Such reactions, when consistent over a long period of time, result in either favorable or unfavorable attitudes toward school itself.

Academic Self-Concept. Similarly, a schedule of success and approval or failure and disapproval over a number of years will lead to the student's generalizing about himself as a learner. This perception of himself is based on feedback he has received in the form of test scores, grades, and reactions from teachers and others. The more evidence he has, the more likely it is that his academic self-concept will be predictive — and determinative of his future academic achievement. As educators, our concern with academic self-concept is primarily as an affective entry characteristic likely to affect achievement of subsequent learning tasks.

In summary there is evidence that affective characteristics are important in determining or influencing the student's achievement, accounting for up to one-fourth of the variance on relevant cognitive achievement measures. These characteristics are based both on the student's past learning history and on his perception of that history. Although affective entry characteristics are likely to become resistant to change after the student has accumulated a long history of experiences with particular types of learning tasks, they can be affected by the quality of instruction.

ADAPTED FROM:

Bloom, Benjamin S. Human Characteristics and School Learning. New York. 1976. Chapter Four. "Affective Entry Characteristics".

Exercise 2.4

Assume that each of the following statements was made by one of your students and each is indicative of that student's attitude toward school, the subject matter, or him or herself as a learner. Rate each statement as indicating a positive attitude (+), a neutral attitude (0), or a negative attitude (-). This exercise will help you to meet Objective 2.4.

___ 1. "I am bored most of the time in school."

___ 2. "The most enjoyable part of my life is the time I spend in school."

___ 3. "I dislike school and will leave just as soon as possible."

___ 4. "I like most school subjects."

___ 5. "Mathematics is interesting and challenging."

___ 6. "Chemistry will be of little value in helping me to reach my life goals."

___ 7. "After this class, I don't want to study any more Spanish."

___ 8. "I get better grades when I study regularly."

___ 9. "I didn't do very well on the midterm because I couldn't find the time to study."

___ 10. "I've never had a teacher who didn't confuse me."

___ 11. "Don't take Spanish with Mr. Smith. His tests are too hard."

___ 12. "I can usually figure out what the teacher means if I work at it."

___ 13. "I usually try to do the homework, even if it isn't graded."

___ 14. "I'll never understand word problems."

SOURCE:

The League for Innovation in the Community College. Teaching in the Community College: An Orientation. New York. HBJ Media Systems Corp. 1981.

Formative Quiz - Unit II

What are the four main criteria which should be used in selecting a textbook?

1. ____
2. ____
3. ____
4. ____
5. A learning unit is defined as an natural break in the content to be covered. True____False_____
6. Learning units are always arranged sequentially (that is, the second unit depends on things learned in the first unit). True___False____
7. The prerequisite types of knowledge required for a learning task are called __________.
8. If learning tasks are arranged sequentially, the most important one are the ___________ in the series.
9. If a student lacks the cognitive entry behaviors for a given learning task, he will not be able to accomplish that task, no matter how much he tries. True____False____

Name three ways in which a teacher can deal with a student who lacks the necessary cognitive entry behaviors for a given learning task.

10. ____
11. ____
12. ____

Name three affective entry characteristics.

13. ____
14. ____
15. ____
16. What is the major factor influencing affect toward school?
    a. high ratio of success experiences to failure experiences
    b. improved academic achievement in a course
    c. the student's perception of his competence in school learning
    d. positive initial school experiences
    e. all of the above.

ANSWERS

Formative Quiz - Unit II

1. Content
2. Organization
3. Assessment or evaluation
4. Format
5. True
6. False
7. Cognitive entry behaviors
8. First ones
9. True
10. Advise student not to take course
11. Tutor him in cognitive entry behaviors
12. Review cognitive entry behaviors with whole class
13. Subject-related affect
14. School-related affect
15. Academic self-concept
16. e

UNIT III
CLASSIFYING OBJECTIVES
AND
USING THE TAXONOMIES

OVERVIEW FOR UNIT III

This unit will introduce the use of objectives in setting up a Mastery Learning course. Objectives are very specific descriptions of what the teacher wants the student to accomplish in a given unit or lesson. By describing the task so exactly, the instructor can see more clearly what he hopes to accomplish with each successive lesson. Preliminary to the use of objectives is the structure of an objective classification system. These classfications structures are usually referred to as taxonomies.

This unit is actually concerned with the classification of these objectives. It will show two separate taxonomies — Bloom's and Gagne's.

Bloom's Taxonomy of Educational Objectives, Handbook 1, the Cognitive Domain, was published in 1956. Bloom and his colleagues identified six different levels of thinking in the learning progress. These range from knowledge, which deals with memorizing facts, to evaluation. (College entrance exams — the ACT and SAT — are based on Bloom's taxonomy.) Robert Gagne of Florida State University developed his taxonomy a decade later. It differs from Bloom's because its focus is different. Bloom concentrates on evaluation, while Gagne is nore concerned with the learning procedure itself. As a result, they break the levels down in different ways, especially within what Bloom calls "the knowledge level."

This unit will also introduce the Table of Specifications, a method of using Bloom's taxonomy to analyze the structure and demands of a particular course. You will not be required to develop a Table of Specifications for your Mastery Learning course, but it is strongly recommended.

OBJECTIVES FOR UNIT III

3.1 Given a set of test items, categorize them on the basis of Bloom's taxonomy.

3.2 Discriminate between the levels of Gagne's taxonomy.

3.3 Translate the levels of Bloom's taxonomy into the levels of Gagne's taxonomy.

3.4 Construct one Table of Specifications for each unit in your course.

TAXONOMY OF EDUCATIONAL OBJECTIVES

There are actually three separate domains in the Taxonomy of Educational Objectives — the Cognitive, the Affective, and the Psychomotor. The cognitive domain is concerned with those objectives which deal with the intellect; the affective domain, with those that have to do with attitudes; and the psychomotor domain, with those that have to do with motor skills.

We are concentrating in this unit on the cognitive domain. This domain contains the hierarchical categories of student behaviors with behaviors in each category of the taxonomy requiring mastery of related behaviors in the preceeding categories.

The six major categories are:

Knowledge

The ability to recall or recognize content in a form virtually identical to that in which it was originally presented. The content may be particular facts, terms, conventions, concepts, rules, generalizations, or procedures. For example, the student must remember who discovered America and when or that $E = mc^2$.

Comprehension

This operation refers to three different abilities: translation, interpretation, and extrapolation. Translation involves the ability to change the content presented from one symbolic form to another. For example, a student must be able to explain the parts of a graph verbally, write a word problem in numerical notation, or change a statement in German to its English equivalent.

Interpretation requires the ability to explain or summarize a body of presented content. Whereas in translation each part of the content must be changed from form to form, interpretation implies that the student must state the overall meaning of the content. For example, a student must be able to summarize a story.

Extrapolation entails the ability of the learner to go beyond the content presented to determine its probable implications, consequences, or effects given the conditions described. For example, the student must frequently draw conclusions on the basis of various readings and/or arguments.

Application

The ability to use the content learned in one situation either to solve a problem or to facilitate learning in a new situation. For example, the student is asked to use the ideas of addition and subtraction to find an error in a mythical Mr. Jones' checkbook. Or the student is asked to use the principle of "perspective" in learning to draw.

Analysis

This operation typically refers to two types of abilities: analysis of elements and analysis of relationships. The analysis of elements requires that the student be able to break down an aggregate presented content (e.g., a document, an object, or a communication) into its constituent parts. For example, the student is requested to find all of the nouns in a paragraph or to dissect a frog.

The analysis of relationships requires that the student be able to see the relationship between one part of an aggregate of content and the other parts of the aggregate. For example, the student is asked to trace a statement made early in a novel to an event that occurs later in the novel. Or the student is asked to find the relationship between the use of color in painting and the evocation of emotions.

Synthesis

The ability to arrange and combine content in such a way as to produce a novel structure, pattern, or idea. At this level, the student must communicate effectively. He also must exercise what some educators would call creative ability. For example, the student is requested to write a theme on "The Three Deadly Enemies of Man" or to put together a class play.

Evaluation

The ability to make both quantitative and qualitive judgments about the way in which particular elements or aggregates of content meet either external or internal criteria. The student must make a judgment about the value or worth of something for some purpose.

The student evaluating on the basis of internal criteria is asked to use logical consistency as his evaluation tool. For example, the student must determine whether a writer's conclusions follow from his data or judge whether a computer program is logical. The student evaluating on the basis of external criteria is asked to use well-specified criteria provided by experts as his evaluation tool. For example, the student is asked to criticize a research article using Borg and Gall's "Checklist for Evaluating Experimental Research in Psychology and Education." Or he is asked to compare the observed outcome with the intended outcome or with the ideal outcome. The student might also be asked to compare the results of his experiment with the correct results or compare his metal work with the model.

Following the condensed version of Bloom's taxonomy is a chart by Kibler, Barker, and Miles which illustrates the objectives. For each classification (i.e., 1.12 Knowledge of Specific Facts) it lists examples of verbs which illustrate it (to recall, to recognize, to acquire, to identify) and of possible direct objects (facts, factual information, etc.)

Thus, an instructor can more easily decide the level of difficulty of a given objective.

Condensed Version of The
Taxonomy of Educational Objectives
Cognitive Domain

KNOWLEDGE

1.00 KNOWLEDGE

Knowledge, as defined here, involves the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting. For measurement purposes, the recall situation involves little more than bringing to mind the appropriate material. Although some alteration of the material may be required, this is a relatively minor part of the task. The knowledge objectives emphasize most the psychological processes of remembering. The process of relating is also involved in that a knowledge test situation requires the organization and reorganization of a problem such that it will furnish the appropriate signals and cues for the information and knowledge the individual possesses. To use an analogy, if one thinks of the mind as a file, the problem in a knowledge test situation is that of finding in the problem or task the appropriate signals, cues, and clues which will most effectively bring out whatever knowledge is filed or stored.

1.10 KNOWLEDGE OF SPECIFICS

The recall of specific and isolable bits of information. The emphasis is on symbols with concrete referents. This material, which is at a very low level of abstraction, may be thought of as the elements from which more complex and abstract forms of knowledge are built.

1.11 KNOWLEDGE OF TERMINOLOGY

Knowledge of the referents for specific symbols (verbal and nonverbal). This may include knowledge of the most generally accepted symbol referent, knowledge of the variety of symbols which may be used for a single referent, or knowledge of the referent most appropriate in a given use of a symbol.

*To define technical terms by giving their attributes, properties, or relations.

*Familiarity with a large number of words in their common range of meanings.

1.12 KNOWLEDGE OF SPECIFIC FACTS

Knowledge of dates, events, persons, places, etc. This may include very precise and specific information such as the specific date or exact magnitude of a phenomenon.

*The recall of major facts about particular cultures.

*The possession of a minimum knowledge about the organisms studied in the laboratory.

1.20 KNOWLEDGE OF WAYS AND MEANS OF DEALING WITH SPECIFICS

Knowledge of the ways of organizing, studying, judging, and criticizing. This includes the methods of inquiry, the chronological sequences, and the standards of judgment within a field as well as the patterns of organization through which the areas of the fields themselves are determined and internally organized. This knowledge is at an intermediate level of abstraction between specific knowledge on the one hand and knowledge of universals on the other. It does not so much demand the activity of the student in using the materials as it does a more passive awareness of their nature.

1.21 KNOWLEDGE OF CONVENTIONS

Knowledge of characteristic ways of treating and presenting ideas and phenomena. For purposes of communication and consistency, workers in a field employ usages, styles, practices, and forms which best suit their purposes and/or which appear to suit best the phenomena with which they deal. It should be recognized that although these forms and conventions are likely to be set up on arbitrary, accidental, or authoritative bases, they are retained because of the general agreement or concurrence of individuals concerned with the subject, phenomena, or problem.

*Familiarity with the forms and conventions of the major types of works, e.g., verse, plays, scientific papers, etc.

*To make pupils conscious of correct form and usage in speech and writing.

1.22 KNOWLEDGE OF TRENDS AND SEQUENCES

Knowledge of the processes, directions, and movements of phenomena with respect to time.

*Understanding of the continuity and development of American culture as exemplified in American life.

*Knowledge of the basic trends underlying the development of public assistance programs.

1.23 KNOWLEDGE OF CLASSIFICATIONS AND CATEGORIES

Knowledge of the classes, sets, divisions, and arrangements which are regarded as fundamental for a given subject field, purpose, argument, or problem.

*To recognize the area encompassed by various kinds of problems or materials.

*Becoming familiar with a range of types of literature.

1.24 KNOWLEDGE OF CRITERIA

Knowledge of the criteria by which facts, principles, opinions, and conduct are tested or judged.

*Familiarity with criteria for judgment appropriate to the type of work and the purpose for which it is read.

*Knowledge of criteria for the evaluation of recreational activities.

1.25 KNOWLEDGE OF METHODOLOGY

Knowledge of the methods of inquiry, techniques, and procedures employed in a particular subject field as well as those employed in investigating particular problems and phenomena. The emphasis here is on the individual's knowledge of the method rather than his ability to use the method.

*Knowledge of scientific methods for evaluating health concepts.

*The student shall know the methods of attack relevant to the kinds of problems of concern to the social sciences.

1.30 KNOWLEDGE OF THE UNIVERSALS AND ABSTRACTIONS IN A FIELD

Knowledge of the major schemes and patterns by which phenomena and ideas are organized. These are the large structures, theories, and generalizations which dominate a subject field or which are quite generally used in studying phenomena or solving problems. These are at the highest levels of abstractions and complexity.

1.31 KNOWLEDGE OF PRINCIPLES AND GENERALIZATIONS

Knowledge of particular abstractions which summarize observations of phenomena. These are the abstractions which are of value in explaining, describing, predicting, or in determining the most appropriate and relevant action or direction to be taken.

*Knowledge of the important principles by which our experience with biological phenomena is summarized.

*The recall of major generalizations about particular cultures.

1.32 KNOWLEDGE OF THEORIES AND STRUCTURES

Knowledge of the body of principles and generalizations together with their interrelations which present a clear, rounded, and systematic view of a complex phenomenon, problem, or field. These are the most abstract formulations, and they can be used to show the interrelation and organization of a great range of specifics.

*The recall of major theories about particular cultures.

*Knowledge of a relatively complete formulation of the theory of evolution.

2.00 COMPREHENSION

This represents the lowest level of understanding. It refers to a type of understanding or apprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

2.10 TRANSLATION

Comprehension as evidenced by the care and accuracy with which the communication is paraphrased or rendered from one language or form of communication to another. Translation is judged on the basis of faithfulness and accuracy, that is, on the extent to which the original communication is preserved although the form of the communication has been altered.

*The ability to understand nonliteral statements (metaphor, symbolism, irony, exaggeration).

*Skill in translating mathematical verbal material into symbolic statements and vice versa.

2.20 INTERPRETATION

The explanation or summarization of a communication. Whereas translation involves and objective part-for-part rendering of a communication, interpretation involves a reordering, rearrangement, or a new view of the material.

*The ability to grasp the thought of the work as a whole at any desired level of generality.

*The ability to interpret various types of social data.

2.30 EXTRAPOLATION

The extension of trends or tendencies beyond the given data to determine implications, consequences, corollaries, effects, etc., which are in accordance with the conditions described in the original communication.

*The ability to deal with the conclusions of a work in terms of the immediate inference made from the explicit statements.

*Skill in predicting continuation of trends.

3.00 APPLICATION

The use of abstractions in particular and concrete situations. The abstractions may be in the form of general ideas, rules of procedures, or generalized methods. The abstractions may also be technical principles, ideas, and theories which must be remembered and applied.

*Application to the phenomena discussed in one paper of the scientific terms or concepts used in other papers.

*The ability to predict the probable effect of a change in a factor on a biological situation previously at equilibrium.

4.00 ANALYSIS

The breakdown of a communication into its constituent elements or parts such that the relative hierarchy of ideas is made clear and/or the relations between the ideas expressed are made explicit. Such analyses are intended to clarify the communication, to indicate how the communication is organized, and the way in which it manages to convey its effects, as well as its basis and arrangement.

4.10 ANALYSIS OF ELEMENTS

Identification of the elements included in a communication.

*The ability to recognize unstated assumptions.

*Skill in distinguishing facts from hypotheses.

4.20 ANALYSIS OF RELATIONSHIPS

The connections and interactions between elements and parts of a communication.

*Ability to check the consistency of hypotheses with given information and assumptions.

*Skill in comprehending the interrelationships among the ideas in a passage.

4.30 ANALYSIS OF ORGANIZATIONAL PRINCIPLES

The organization, systematic arrangement, and structure which hold the communication together. This includes the "explicit" as well as "implicit" structure. It includes the bases, necessary arrangement, and the mechanics which make the communication a unit.

*The ability to recognize form and pattern in literary or artistic works as a means of understanding their meaning.

*Ability to recognize the general techniques used in persuasive materials, such as advertising, propaganda, etc.

5.00 SYNTHESIS

The putting together of elements and parts so as to form a whole. This involves the process of working with pieces, parts, elements, etc., and arranging and combining them in such a way as to constitute a pattern or structure not clearly there before.

5.10 PRODUCTION OF A UNIQUE COMMUNICATION

The development of communication in which the writer or speaker attempts to convey ideas, feelings, and/or experiences to others.

*Skill in writing, using an excellent organization of ideas and statements.

*Ability to tell a personal experience effectively.

5.20 PRODUCTION OF A PLAN, OR PROPOSED SET OF OPERATIONS

The development of a plan of work or the proposal of a plan of operations. The plan should satisfy requirements of the task which may be given to the student or which he may develop for himself.

*Ability to propose ways of testing hypotheses.

*Ability to plan a unit of instruction for a particular teaching situation.

5.30 DERIVATION OF A SET OF ABSTRACT RELATIONS

The development of a set of abstract relations either to classify or explain particular data or phenomena, or the deduction of propositions and relations from a set of basic propositions or symbolic representations.

*Ability to formulate appropriate hypotheses based upon an analysis of factors involved, and to modify such hypotheses in the light of new factors and considerations.

*Ability to make mathematical discoveries and generalizations.

6.00 EVALUATION

Judgments about the value of material and methods for given purposes. Quantitative and qualitative judgments about the extent to which material and methods satisfy criteria. Use of a standard of appraisal. The criteria may be those determined by the student or those which are given to him.

6.10 JUDGMENTS IN TERMS OF INTERNAL EVIDENCE

Evaluation of the accuracy of a communication from such evidence as logical accuracy, consistency, and other internal criteria.

*Judging by internal standards, the ability to assess general probability of accuracy in reporting facts from the care given to exactness of statement, documentation, proof, etc.

*The ability to indicate logical fallacies in arguments.

6.20 JUDGMENTS IN TERMS OF EXTERNAL CRITERIA

Evaluation of material with reference to selected or remembered criteria.

*The comparison of major theories, generalizations, and facts about particular cultures.

*Judging by external standards, the ability to compare a work with the highest known standards in its field — especially with other works of recognized excellence.

SOURCE: Bloom, Benjamin S. et al. *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain*. New York: Longman Inc., 1977.

TABLE I: INSTRUMENTATION OF THE TAXONOMY OF EDUCATIONAL OBJECTIVES: COGNITIVE DOMAIN

(Kibler, R.J., Barker, L.L., and Miles, D.T., Behavioral Objectives and Instruction, Allyn and Bacon, 1970)

Taxonomy Classification	Examples of Infinitives	Examples of Direct Objects
1.00 Knowledge		
1.10 Knowledge of Specifics		
1.11 Knowledge of Terminology	to define, to distinguish, to acquire, to identify, to recall, to recognize	vocabulary, terms, terminology, meaning(s), definitions, referents, elements
1.12 Knowledge of Specific Facts	to recall, to recognize, to acquire, to identify	facts, factual information, (souces), (names), (dates), (events), (persons), (places), (time periods), properties, examples, phenomena
1.20 Knowledge of Ways and Means of Dealing with Specifics		
1.21 Knowledge of Conventions	to recall, to identify, to recognize, to acquire	form(s), conventions, uses, usage, rules, ways, devices, symbols, representations, style(s), format(s)
1.22 Knowledge of Trends, Sequences	to recall, to recognize, to acquire, to identify	action(s), processes, movement(s), continuity, development(s), trend(s), sequences(s), causes, relationship(s), forces, influences
1.23 Knowledge of Classifications and Categories	to recall, to recognize, to identify, to acquire	area(s), type(s), feature(s), class(es), set(s), division(s), arrangement(s), classification(s), category/categories
1.24 Knowledge of Criteria	to recall, to recognize, to acquire, to identify	criteria, basics, elements

TABLE I (continued)

Taxonomy Classification	Examples of Infinitives	Examples of Direct Objects
1.25 Knowledge of Methodology	to recall, to recognize, to acquire, to identify	methods, techniques, approaches, uses, procedures, treatments
1.30 Knowledge of the Universals and Abstractions in a Field		
1.31 Knowledge of Principles, Generalizations	to recall, to recognize, to acquire, to identify	principle(s), generalization(s) proposition(s), fundamentals, laws, principal elements, implication(s)
1.32 Knowledge of Theories and Structures	to recall, to recognize, to acquire, to identify	theories, bases, interrelations, structure(s), organization(s), formulation(s)
2.00 Comprehension		
2.10 Translation	to translate, to transform, to give in own words, to illustrate, to prepare, to read, to represent, to change, to rephrase, to restate	meaning(s), sample(s), definitions, abstractions, representations, words, phrases
2.20 Interpretation	to interpret, to reorder, to rearrange, to differentiate, to distinguish, to make, to draw, to explain, to demonstrate	relevancies, relationships, essentials, aspects, new view(s), qualifications, conclusions, methods, theories, abstractions
2.30 Extrapolation	to estimate, to infer, to conclude, to predict, to differentiate, to determine, to extend, to interpolate, to extrapolate, to fill in, to draw	consequences, implications, conclusions, factors, ramifications, meanings, corollaries, effects, probabilities

3.00	Application	to apply, to generalize, to relate, to choose, to develop, to organize, to use, to employ, to transfer, to restructure, to classify	principles, laws, conclusions, effects, methods, theories, abstractions, situations, generalizations, processes, phenomena, procedures
4.00	Analysis		
4.10	Analysis of Elements	to distinguish, to detect, to identify, to classify, to discriminate, to recognize, to categorize, to deduce	elements, hypothesis/hypotheses, conclusions, assumptions, statements (of fact), statements (of intent), arguments, particulars
4.20	Analysis of Relationships	to analyze, to contrast, to compare, to distinguish, to deduce	relationships, interrelations, relevance/relevancies, themes, evidence, fallacies, arguments, cause-effect(s), consistency/consistencies, parts, ideas, assumptions
4.30	Analysis of Organizational Principles	to analyze, to distinguish, to detect, to deduce	form(s), pattern(s), purpose(s), point(s) of view, techniques, bias(es), structure(s), organization(s)
5.00	Synthesis		
5.10	Production of a Unique Communication	to write, to tell, to relate, to produce, to constitute, to transmit, to originate, to modify, to document	structure(s), pattern(s), product(s), performance(s), design(s), work(s), communications, effort(s), specifics, composition(s)
5.20	Production of Plan, or Proposed Set of Operations	to propose, to plan, to produce, to design, to modify, to specify	plan(s), objectives, specification(s), schematic(s) operations, way(s), solution(s), means

5.30 Derivation of a Set of Abstract Relations	to produce, to derive, to develop, to combine, to organize, to synthesize, to classify, to deduce, to develop, to formulate, to modify	phenomena, taxonomies, concept(s), scheme(s), theories, relationships, abstractions, generalizations, hypothesis/hypotheses, perceptions, ways, discoveries
6.00 Evaluation		
6.10 Judgments in Terms of Internal Evidence	to judge, to argue, to validate, to assess, to decide	accuracy/accuracies, consistency/consistencies, fallacies, reliability, flaws, errors, precision, exactness
6.20 Judgments in Terms of External Criteria	to judge, to argue, to consider, to compare, to contrast, to standardize, to appraise	ends, means, efficiency, economy/economies, utility, alternatives, course of action, standards, theories, generalizations

Exercise 3.1

Classify the following test items according to the categories of the Taxonomy in Table I. To make this task easier, select your answers from the following list. This will fulfill objective 3.1.

1. 1.11
2. 1.12
3. 1.21
4. 1.22
5. 1.24
6. 1.25
7. 1.31
8. 1.32
9. 2.10
10. 4.30

____ 1. A sodium ion differs from a sodium atom in that

A. it is an isotope of sodium
B. it is more reactive
C. it has a positive charge on its nucleus
D. it exists only in solution
E. it has fewer electrons

____ 2. Which one of the following phrases about wave motion defines period?

1. The maximum distance a particle is displaced from its point of rest.
2. The length of time required for a particle to make a complete vibration.
3. The number of complete vibrations per second.
4. The time rate of change of distance in a given direction.

____ 3. The general structure of the composition is

1. theme and variations
2. theme, development, restatement
3. theme 1, development; theme 2,
4. introduction, theme, development

____ 4. "The ideal systems of primitive groups of people are highly restricted and traditional in content and, in addition, have been transmuted into customary ways of doing things." This best illustrates

A. the stability of the primitive social organization
B. how primitive people evaluate the worth of ideas
C. the change of ideas to action
D. the repetition of customary ways of doing things
E. the slow progress of primitive peoples

____ 5. The criterion Darwin uses to distinguish the more variable species from the less variable species in Chapter II is

A. number of individuals in the species.
B. frequency of individual differences in the species.
C. number of varieties in the species.
D. number of closely related species.
E. number of different climatic conditions tolerated by the species.

____ 6. Of the following, which represents the most important differences between the scientific method as used in the social sciences and as used in the natural sciences?

1. Employment of the deductive rather than the inductive method of reasoning.
2. Study of the developmental aspects of various problems.
3. Necessity of understanding hypotheses as tentative in nature.
4. Importance of understanding the problem of causation.
5. Necessity of recognizing the value judgments of the investigation.

____7. If the volume of a given mass of gas is kept constant, the pressure may diminished by

1. reducing the temperature.
2. raising the temperature.
3. adding heat.
4. decreasing the density.
5. increasing the density.

____ 8. Directions: Items 60-62 are concerned with possible evidences in support of the theory of biological evolution. Select from the key list the category to which the evidence mentioned in the item belongs.

1. Comparative anatomy
2. Comparative physiology
3. Classification
4. Embryology
5. Paleontology

60. Intergrading forms of plants and animals differing from earlier species indicate that evolutionary change is probable taking place today in all living organism.

61. Hematin crystals from the hemoglobin of various vertebrates have the same chemical composition.

62. The human heart has two chambers at a very early developmental stage.

____ 9. The stages in the life history of the housefly are, in order,

1. larva - egg - pupa - adult.
2. pupa - larva - egg - adult.
3. pupa - egg - larva - adult
4. egg - larva - adult - pupa.
5. egg - larva - pupa - adult.

____ 10. Magnetic poles are usually named

1. plus and minus.
2. red and blue.
3. east and west.
4. north and south.
5. anode and cathode.

SOURCE: Bloom, Benjamin S. et al. Taxonomy of Educational Objectives - Handbook I: Cognitive Domain. New York: Longman Inc., 1977.

GAGNE'S TAXONOMY

Remember that the chief difference between Bloom's Taxonomy and Gagne's is that Bloom concentrates on the evaluation process while Gagne concentrates on the learning process. Many of their classifications are parallel, as the chart below makes clear.

TYPES OF THINKING	BLOOM'S TAXONOMY	GAGNE'S TAXONOMY
Problem Solving	Evaluation Synthesis Analysis Application	Problem Solving
Reasoning	Comprehension	Rules (Defined Concepts)
Remembering	Knowledge	Concrete Concepts Discriminations

Fig. 3.1
(adapted from a chart by Dr. Bruce McDonald, Southern Illinois University)

Gagne is interested in which skills are necessary at each level so that the learner may move on to a higher level of complexity.

The following is the chart Gagne himself uses to show the interrelationships between the four levels of intellectual skills listed above:

PROBLEM SOLVING

(HIGHER-ORDER RULES)

requires as prerequisites

RULES

(including DEFINED CONCEPTS)

which require as prerequisites

CONCRETE CONCEPTS

which require as prerequisites

DISCRIMINATIONS

Condensed Version of
VARIETIES OF LEARNING:
INTELLECTUAL SKILLS AND STRATEGIES

Discriminations

A discrimination is a capablility of making responses to stimuli which differ from each other along one or more physical dimensions. Examples in secondary and adult education may occur with stimuli encountered in art, music, foreign languages, and science.

Performance There must be a response which indicates that the learner can distinguish stimuli which differ on one or more physical dimensions. Often this is an indication of same or different.

Internal Conditions On the sensory side, the physical difference must give rise to different patterns of brain activity. Otherwise, the individual must have available only the responses necessary to indicate that the difference is detectable, as in saying "same" and "different." The required responses may be as simple as pointing, making a checkmark, or drawing a circle around a pictured object.

External Conditions The learning of discriminations involves three principles:

1) Contiguity (The response must follow the stimuli within a short time span),

2) Reinforcement, and

3) Repetition

Concrete Concepts

A concept is a capability that makes it possible for an individual to identify a stimulus as a member of a class having some characteristic in common, even though such stimuli may otherwise differ from each other markedly. A concrete concept identifies an object property or object position. Such concepts are called "concrete" because the human performance they require is recognition of a concrete object.

Examples of object properties are round, square, blue, three, smooth, curved, flat, and so on. Examples of object positions are above, below, beside, surrounding, right, left, middle, on, in front of.

Performance Identifying a class of object properties, including object positions, by "pointing to" two or more members of the class. The "pointing" may be done in any number of ways (checking, circling, and so on) equivalent only in the sense that identification occurs.

Internal Conditions In acquiring a concrete concept, discriminations must be recalled.

External Conditions of the class are presented, varying as widely as possible in their nonrelevant characteristics, and the individual is asked to identify each by "pointing" or naming. Negative instances are often of value as well.

Defined Concepts

An individual is said to have learned a defined concept when he can demonstrate the meaning of some particular class of objects, events, or relations. For example, consider the concept "alien," a citizen of a foreign country. An individual who has learned such a concept will be able to classify a particular person in accordance with the definition, by showing that that person is currently in a country of which he is not a citizen, and that he is a citizen of some other country.

Performance The learner will demonstrate the concept by identifying instances of concepts which are components of the definition, and showing an instance of their relation to one another.

Internal Conditions In order to acquire a concept by definition, the learner must recall all of the component concepts included in the definition, including the concepts which represent relations among them.

External Conditions A defined concept may be learned by having the learner watch a demonstration. Most frequently, though, the concept is "demonstrated" by means of a verbally stated definition.

Rules

A rule has been learned when it is possible to say with confidence that the learner's performance has a kind of "regularity" over a variety of specific situation. In other words, the learner shows that he is able to respond with a class of relationships among classes of objects and events. Obviously, possessing the capability called a rule does not mean being able to state it verbally.

A defined concept, as previously described, is a particular type of rule whose purpose it is to classify objects and events; it is a classifying rule. Rules, however, include many other categories besides classifying. They deal with such relationships as equal to, similar to, greater than, less than, before, after, and many, many others.

Performance The rule is demonstrated by showing one or more instances of the relation of the component concepts to one another; in other words, by applying the rule to some concrete instances.

Internal Conditions In learning a rule, the learner must recall each of the component concepts of the rule, including the concepts that represent relation.

External Conditions Usually, the external conditions for learning rules involve the use of verbal communications. The basic reasons for the verbal communication are two: (1) to remind the learner of component concepts to be recalled, and (2) to get the learner to arrange the concepts in the proper order.

Higher-Order Rules — Problem Solving

Sometimes, the rules which human beings learn are complex combinations of simpler rules. Moreover, it is often the case that these more complex, or "higher-order," rules are invented for the purpose of solving a practical problem or class of problems. The capability of problem solving is, naturally, a major aim of the educational process — most educators agree that the school should give priority to teaching students to think clearly.

The essential condition that distinguishes a problem-solving learning experience is the absence of any learning guidance, whether in the form of a verbal communication or some other form.

Performance The performance would require invention and use of a complex rule to achieve the solution of a problem which is novel to the individual. When the higher-order rule has been acquired, it should also be possible for the learner to demonstrate its use in other physically different, but formally similar, situations. In other words, the new complex rule which has been acquired exhibits transfer of learning.

Internal Conditions Internal Conditions In solving a problem, the learner must recall relevant subordinate rules and also relevant information. It is assumed that these capabilities have been previously learned.

External Conditions The learner is confronted with an actual or a represented problem situation not previously encountered. Cues in the form of verbal communications are at a minimum, or may be absent entirely. The learner engages in "discovery learning;" he or she invents a solution.

Adapted from
Gagne, Robert M. & Briggs, Leslie J. Principles of Instructional Design, 2nd Edition. New York. Holt, Rinehart & Winston. 1979.

Exercise 3.2

Answer the following questions on Gagne's taxonomy. This will fulfill objective 3.2.

1. What are the four levels of skills that Gagne describes?
2. Why are discriminations necessary before a student moves on to concepts?
3. What is the difference between concrete concepts and defined concepts?
4. Name other relationships which could be classified under "rules" besides defined concepts.
5. How does problem solving differ from lower-order rules?

TABLES OF SPECIFICATIONS

A table of specifications is a two-dimensional chart which relates the topics from your topical outline to the levels of Bloom's taxonomy. It is a useful tool because it helps the instructor classify the learning skills and determine the level of difficulty of a given unit. The table also makes it easier for the instructor to determine if there are gaps in the unit, to spot interrelationships among the learning skills, and to determine hierarchies and prerequisites.

There are three steps to developing a table of specifications:

1) List the categories of Bloom's taxonomy across the top of the page.
2) List the course content under the appropriate categories. (For example, "Revise sales journal to meet needs" belongs under Ability to Make Applications.)
3) Draw lines connecting a topic at one level to those topics at more complex levels for which the first topic is a prerequisite. (For example, students are expected to have mastered addition and subtraction before trying to solve more difficult algebraic equations.)

All three of these steps must be followed in order to construct a table of specifications. On the following pages are a few tables of specifications to show you ways in which they might be constructed.

Exercise 3.3

Construct a table of specifications for one of the learning units developed in Unit II. We will provide forms for the tables with Bloom's categories listed across the top. You must:

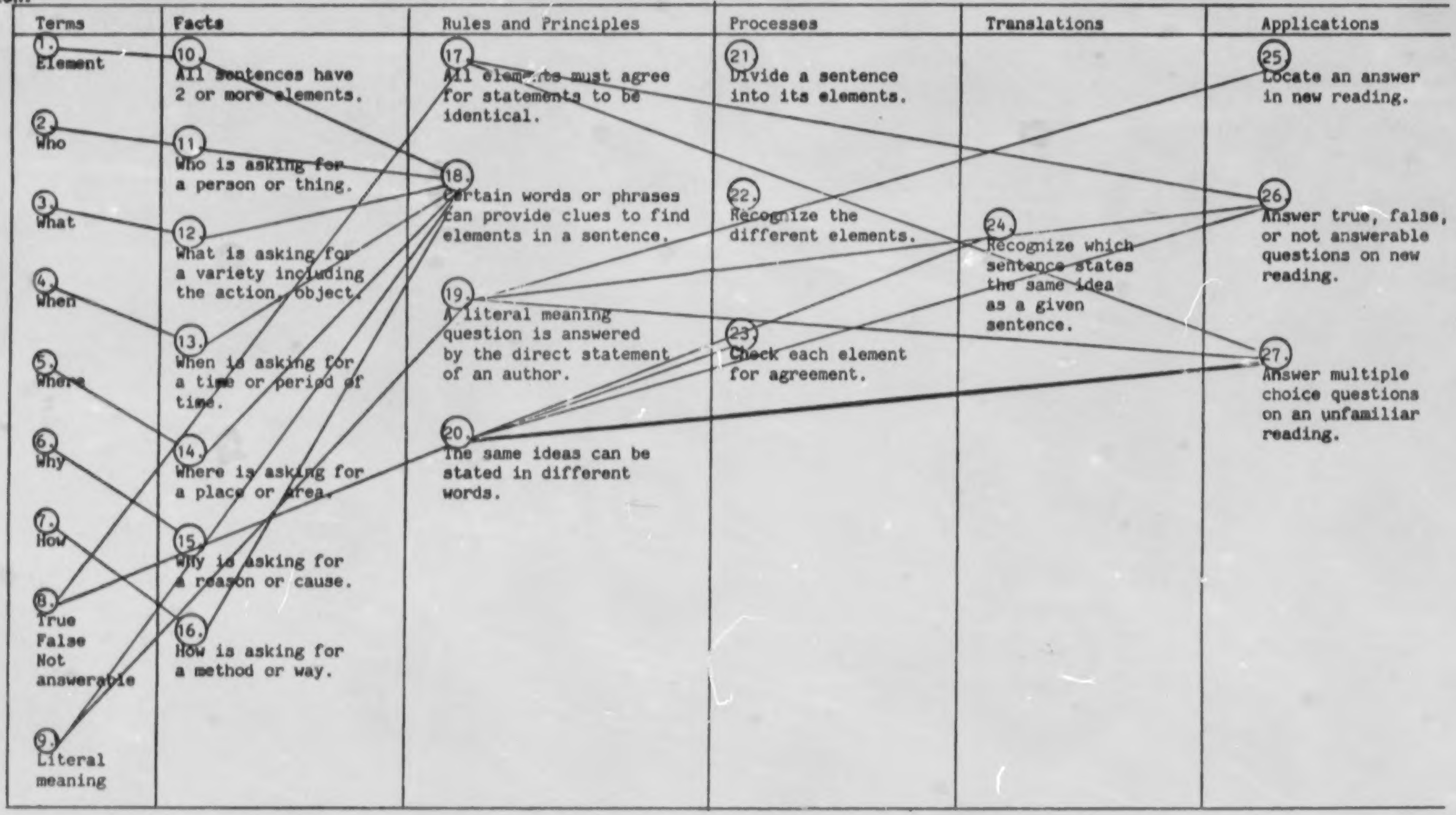
1) Identify each entry in your topical outline with one or more categories that you think fit within the behavioral level of the taxonomy, and
2) Develop the structural connections between entries by drawing lines that display which elements are prerequisite to other entries within the learning unit.

This exercise is optional but highly recommended. It will help you meet objective 3.3.

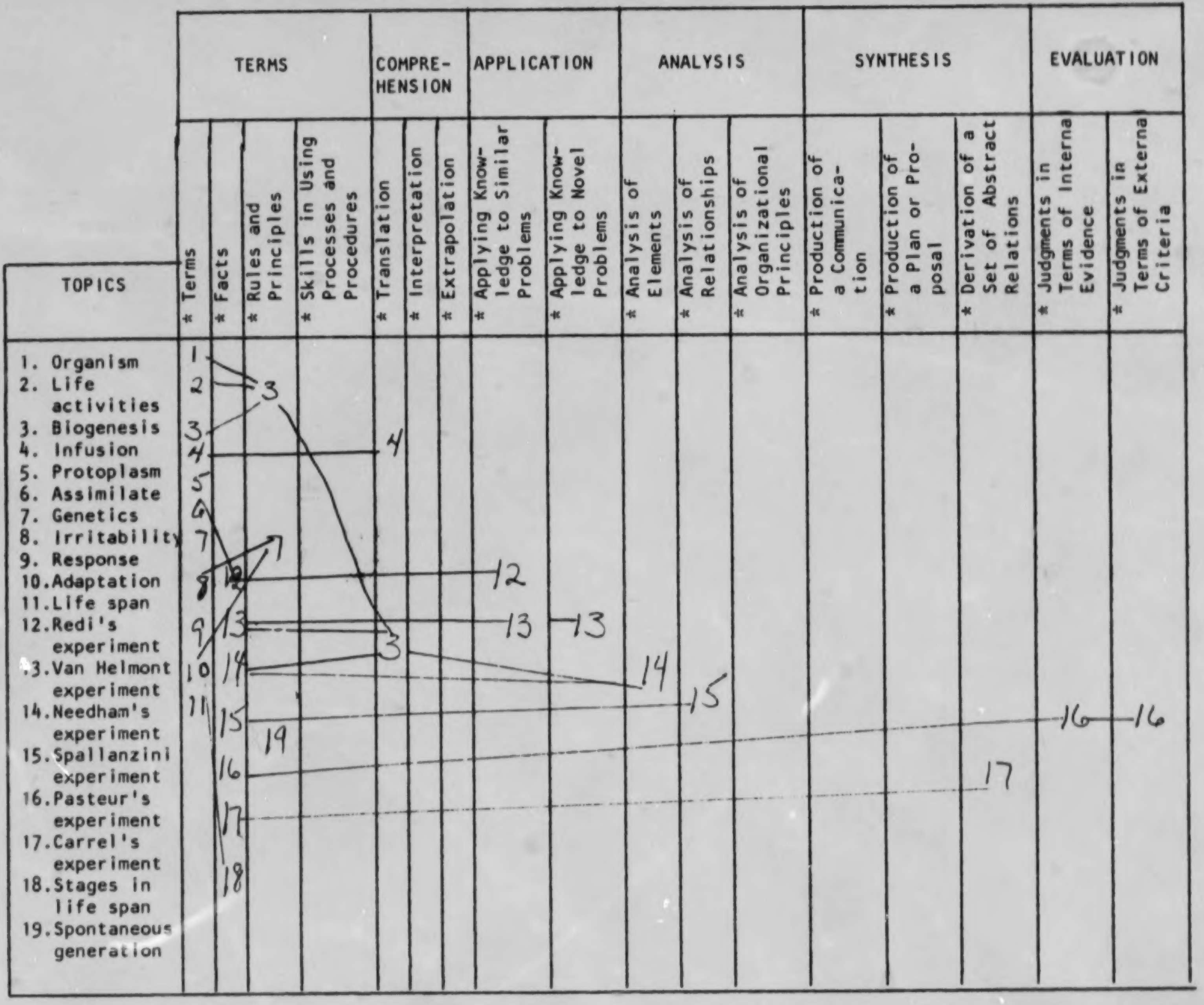
SPECIFICATIONS

LITERAL MEANING UNIT

READING -- EDUCATION 553
Nancy DeSombre
WRIGHT



Terms	Facts	Rules and Principles	Processes	Translations	Applications
1. Element	10. All sentences have 2 or more elements.	17. All elements must agree for statements to be identical.	21. Divide a sentence into its elements.		25. Locate an answer in new reading.
2. Who	11. Who is asking for a person or thing.	18. Certain words or phrases can provide clues to find elements in a sentence.	22. Recognize the different elements.	24. Recognize which sentence states the same idea as a given sentence.	26. Answer true, false, or not answerable questions on new reading.
3. What	12. What is asking for a variety including the action, object.	19. A literal meaning question is answered by the direct statement of an author.	23. Check each element for agreement.		27. Answer multiple choice questions on an unfamiliar reading.
4. When	13. When is asking for a time or period of time.	20. The same ideas can be stated in different words.			
5. Where	14. Where is asking for a place or area.				
6. Why	15. Why is asking for a reason or cause.				
7. How	16. How is asking for a method or way.				
8. True False Not answerable					
9. Literal meaning					



TOPICS	TERMS				COMPRE-HENSION			APPLICATION		ANALYSIS			SYNTHESIS			EVALUATION	
	* Terms	* Facts	* Rules and Principles	* Skills in Using Processes and Procedures	* Translation	* Interpretation	* Extrapolation	* Applying Knowledge to Similar Problems	* Applying Knowledge to Novel Problems	* Analysis of Elements	* Analysis of Relationships	* Analysis of Organizational Principles	* Production of a Communication	* Production of a Plan or Proposal	* Derivation of a Set of Abstract Relations	* Judgments in Terms of Internal Evidence	* Judgments in Terms of External Criteria
1. Organism 2. Life activities 3. Biogenesis 4. Infusion 5. Protoplasm 6. Assimilate 7. Genetics 8. Irritability 9. Response 10. Adaptation 11. Life span 12. Redi's experiment 13. Van Helmont experiment 14. Needham's experiment 15. Spallanzini experiment 16. Pasteur's experiment 17. Carrel's experiment 18. Stages in life span 19. Spontaneous generation	1 2 3 4 5 6 7 8 9 10 11	12 13 14 15 16 17 18	3 19		4 3			12 13	13	14	15				17	16	16

FORMATIVE - UNIT THREE

A. Select your answers from the following list of categories from Bloom's taxonomy: 1.23, 2.20, 2.30, 3.00, 4.10, 4.20, 5.10, 5.20, 5.30, 6.10, and 6.20.

____ 1. A Problem in Chemical Process Design

The following problem was used in a course in chemical engineering. The student must prepare a process design which meets the specifications outlined in the accompanying letter.

AJAX PETROLEUM CORPORATION
Office of the Chief Engineer
March 5, 1951

To Process Engineering Division:

Our management has decided to increase the output of aviation gasoline based stock from our East Chicago Refinery. The only major addition to the refinery necessary will be a butane isomerization unit. The engineering schedule requires that the process engineering and cost estimate must be completed and the information transmitted to the Mechanical Engineering Department by April 4, 1951. The process design should be in our usual report form and include a flow diagram, utilities required, equipment specifications, instrumentation, and drawings of the plot plan and elevation. The isomerization process is to be selected by you, and your choice should be supported by adequate arguments and description.

Will you please proceed according to your best judgment based upon the attached conditions.

Very truly yours,
AJAX PETROLEUM CORPORATION

A Problem in Chemical Process Design (continued)

Ajax Petroleum Corporation
100 BFSD Butane Isomerization Unit
East Chicago, Illinois
Job. 774

Site: 175 feet x 150 feet, level at NE corner of catalytic unit. Soil bearing load 3,000 lbs./sq. ft. 6 feet below grade.

Feed Stock:

Source: De-ethanized catalytic cracker gas.

Pressure: 275 psig at battery limits.

compostion:	lbs./hour
ethane	30
proprane	2850
iso butane	4560
n-butane	845
pentane	750
Propylene	80
butylenes	140
water	saturated

Yield: 1000 bbl./stream day 98% isobutane

Storage: 30 days product storage required

Utilities: water: available at 40 psig
72° F maximum summer temperature.
37° F minimum winter temperature.

Electricity: 110 v single phase and 220/440 3 phase.

Steam: 250 psig - 50° F superheat
5 psig - saturated

____ 2. The following exercises can be used to test the ability to make up short stories. Each may be given as an oral or written exercise, with or without much preparation on the part of the storyteller.

"Think of some time in your own life when you were up against a difficulty, something that stood in your way and had to be overcome. Make up a story around this difficulty and tell it to the class."

"Think of a plot based upon an obstacle that could occur between the following two sentences, and then develop a short story using these sentences and your plot."

It was an event to be honored with a party, preferably a surprise party... "It was a surprise, all right — a surprise all the way around!"

____ 3. Given an end, recognize best of several means

Many people believe that it would be better if our states had more uniform divorce laws. It is recognized, however, that there are dangers in an attempt to achieve such uniformity. Which one of the following procedures would be most likely to avoid the greatest of these dangers?

A- An amendment to the U.S. Constitution is passed, which establishes the grounds for divorce to be recognized in all courts.
B- A federal law is passed which sets forth the maximum grounds which can be recognized by any state.
C- A commission appointed by the president works out standards for a divorce code and encourages all states to consider these standards in revising their laws.
D- A conference of state governors decides on a divorce code and each governor attempts to have it made the law of his state.
E- The U.S. Supreme Court establishes a uniform set of practices by ruling against all divorce laws which do not conform to its standard.

____ 4. Social Security officials sometimes face perplexing problems in studying appeals for unemployment compensation. Some major-league baseball players in Ohio and Missouri decided in January that, because they had not played ball since the end of the season, they had a right to consider themselves unemployed. Although some of them were earning good salaries of $8,000 to $10,000 a year in baseball, they maintained that they were entitled to the benefits of the unemployment section of the Social Security Act.

Team owners urged these players not to apply for unemployment compensation. According to the owners' interpretation, the players were under contract all year around, although they worked and were paid only during the playing season. On the other hand, the state officials in Ohio and Missouri were inclined to agree with the players that they were entitled to benefit payments.

Directions: Examine the conclusions given below. Assuming that the paragraphs above give a fair statement of the problem, which one of the conclusions do you think is justified?

Conclusions:

A. The players were entitled to the benefits of the unemployment section of the Social Security Act.
B. The players were not entitled to the benefits of the unemployment section of the Social Security Act.
C. More information is needed to decide whether or not the players were entitled to the benefits of the unemployment section of the Social Security Act.

Mark in A: Statements which explain why your conclusion is logical.
B: Statements which do not explain why your conclusion is logical
C: Statements about which you are unable to decide.

Statements
1. The state officials are the ones who consider appeals for unemployment compensation, and their opinion carries more weight than the opinions of team owners.
2. The Social Security Act may or may not provide that a man who works and receives pay during only part of each year is unemployed during the remaining part of the year.

____ 5. An electric iron (110 volts, 1,000 watts) has been used for some time and the plug contacts have become burned, thus introducing additional resistance. How will this affect the amount of heat which the iron produces?

Directions: Choose the conclusion which you believe is most consistent with the facts given above and most reasonable in the light of whatever knowledge you may have, and mark the appropriate space on the Answer Sheet under Problem VI.

Conclusions:
A. The iron will produce more heat than when new.
B. The iron will produce the same heat as when new.
C. The iron will produce less heat than when new.

Directions: Choose the reasons you would use to explain or support your conclusion and fill in the appropriate spaces on your Answer Sheet. Be sure that your marks are in one column only—the same column in which you marked the conclusion.

Reasons:
1. The heat produced by an electrical device is always measured by its power rating. It is independent of any contact resistance.
2. Electric current of the same voltage always produce the same amount of heat, and burned contacts do not decrease the amount of electricity entering the iron.
3. The current which flows through the iron is reduced when the resistance is increased.
4. Increasing the resistance in an electrical circuit increases the current.
5. An increase in electrical resistance increases the heat developed.
6. Manufacturers of electric irons urge that the contacts be kept clean to maintain maximum efficiency.
7. An increase in the temperature of a wire usually results in an increase in its resistance.
8. Burned contacts increase the heat developed in an electric iron just as increasing the friction in automobile brakes develops more heat.
9. The heat developed by an electric iron when connected to 110 volts is independent of the flow of current.

____ 6. Directions: Below are some statistics relating to education and occupations. You are to judge what conclusions may be drawn from them.

	Occupational distribution found in a sample of male college graduates*	Distribution of occupations in the population as a whole, 1950

OCCUPATIONS		PERCENTAGES
Executives, minor officals, partners, proprietors	23.5	9.1
Professional workers	51.3	4.7
Salesmen	6.0	Less than 1%
Skilled workers	7.1	33.8
Clerical workers	8.7	13.4
Unskilled workers	1.7	26.1
Farmers	1.7	13.0
	100.00	100.0

* You may assume that the sample selected is representative of all male college graduates in the United States.

Below are a series of statements relating to occupations and educations. Blacken the answer space

A - if the foregoing statistics alone are sufficient to prove the statement true;
B - if the foregoing statistics alone are sufficient to indicate that the statement is probably true;

C - if the foregoing statistics alone are not sufficient to indicate whether there is any degree of truth or falsity in the statement;
D - if the foregoing statistics alone are sufficient to indicate that the statement is probably false;
E - if the foregoing statistics alone are sufficient to prove the statement false.

30. Typically farmers are completely uneducated.

31. The professions absorb a larger percentage of male college graduates than any other group in the country.

32. Sons of unskilled workers and of farmers have an approximately equal chance to go to college.

33. Educational opportunity for the lower classes is increasing.

34. The same proportions of farmers and of unskilled workers are college graduates.

____ 7. In the chart given below, amounts spent for any given state function all read from the base line. For example, interest and retirement of the state debt required the expenditure of 40 million dollars in 1938, rather than 40 million minus 21.

After the number on the answer sheet corresponding to that of each statement, blacken space

A if the information given in the chart is sufficient for a judgment that the statement is definitely true.
B if the information given in the chart is sufficient only to indicate that the statement is probably true.
C if the information given in the chart is not sufficient to indicate any degree of truth of falsity in the statement.
D if the information given in the chart is sufficient for a judgment that the statement is probably false.
E if the information given in the chart is sufficient for a judgment that the statement is definitely false.

62. Less money was spent in 1930 than before 1929 for welfare and education.
63. In 1931 and 1932 the expenditure of money for highway purposes was evidently considered a means of combatting the depression.

64. Had our country not entered the war in 1941, expenditures for welfare in 1942 would have been greater than in 1940.

65. In 1940 a much greater proportion of the total expenditures were for welfare than in 1942.

66. The increasing amount of money spent by the State for all purposes between 1929 and 1940 must have come from sources other than borrowing.

____ 8. The formulation of reasonable hypothesis: A housing concern has made some experiments on methods of heating houses. A room was constructed with walls that could be heated or refrigerated at the same time that air of any temperature was being circulated through the room. Several individuals were asked to record their sensations as the conditions were varied as follows:

Trial	Wall Temp	Air Temp	Sensations
1	85°	85°	Uncomfortably hot
2	85°	50°	Uncomfortably hot
3	70°	85°	Comfortable
4	70°	70°	Comfortable
5	70°	50°	Comfortable
6	50°	50°	Very cold
7	50°	70°	Cold
8	50°	85°	Cold

How can you explain the sensation of "coldness" by a person in a room where the air temperature is 85° and the wall temperature is 50° (all temperatures Fahrenheit)? Consider the following questions and organize your thinking under the outline given below.

a) Make all the suggestions you can which you believe will explain why a person is cold in a room where the air temperature is 85° and the wall temperature is 50°. Give your reasons as to why you believe each of these suggestions will explain the phenomenon.

b) What kinds of evidence would you want to collect which would enable you to decide amoung your suggested hypotheses?

c) Now go over the suggestions which you have made above and select the one which you believe to be the "best" explanation and give your reasons for your selection.

____ 9. Statement of facts: The following table represents the relationship between the yearly income of certain families and the medical attention they receive.

Family Income	Per Cent of Family Members Who Received No Medical Attention During the Year
Under $1,200	47
$1,200 to $3,000	40
$3,000 to $5,000	33
$5,000 to $10,000	24
Over $10,000	14

Conclusion: Members of families with small incomes are healthier than members of families with large incomes.
Which one of the following assumptions would be necessary to justify the conclusion?
1. Wealthy families had more money to spend for medical care.
2. All members of families who needed medical attention received it.
3. Many members of families with low incomes were not able to pay their doctor bills.
4. Members of families with low incomes often did not receive medical attention.

____ 10. A and B were arguing about the desirability of adopting a nationwide system of compulsory health insurance in the United States. B said that, while he had no fundamental objection to health insurance, he felt strongly that people should not be compelled to participate in it. "Now, look here," he said, "Do the people want health insurance or don't they? I don't think they do, but in either case, compulsory insurance is bad. If the people really want health insurance, there is no need for compulsion. If they don't want it, it is impossible to force them to participate. And so the answer is clear." Which of the following statements most nearly expresses the logical conclusion of B's argument?
1. Health insurance is bad.
2. Compulsory health insurance is bad.
3. Compulsion is impossible.
4. Compulsion is unnecessary.
5. Compulsion is either unnecessary or impossible.

____ 11. An engineer who designs houses is called:
1. a carpenter.
2. a civil engineer.
3. an architect.
4. a draftman.
5. a mechanical engineer.

SOURCE: Bloom, Benjamin S. et al. Taxonomy of Educational Objectives, Handbook I: Cognitive Domain. New York: Longman Inc., 1977.

B. Below are the six levels of Bloom's taxonomy. List the equivalent level from Gagne's taxonomy.

1. Knowledge of terms ____________________
2. Knowledge of facts ____________________
3. Knowledge of rules and principles ____________________
4. Skill in using processes and procedures ____________________
5. Ability to make translations ____________________
6. Ability to make applications ____________________

C. Listed below are five objectives from a business course. Place them in the proper space in the table of specifications.

1. Post from cash disbursement journal
2. Revise CRJ to meet needs
3. Comparison between Schedule of accts. receivable and Acct. receivable control account
4. Accounts payable level
5. Install a subsidiary ledger.

Knowledge of Terms	Knowledge of Facts	Knowledge Rules and Principles	Skill in Using Process and Procedures	Ability to Make Translations	Ability to Make applications

ANSWERS

I. Exercise 3.1
1. 1.12
2. 1.11
3. 4.30
4. 2.10
5. 1.24
6. 1.25
7. 1.31
8. 1.32
9. 1.22
10. 1.21

II. Exercise 3.2

1. What are the four levels of intellectual skills that Gagne described?

   The four levels are:
   1) Discriminations
   2) Concrete concepts
   3) Rules (defined concepts)
   4) Higher-order rules — problem solving

2. Why are discriminations necessary before a student moves on to concepts?

   A student must be able to make distinctions before he can group all of those things that share the same quality. For example, he must be able to tell 2 from 3 before he can point out all the groups of 3.

3. What is the difference between concrete concepts and defined concepts?

   Concrete concepts can be taught and demonstrated nonverbally by pointing. Defined concepts are usually demonstrated by means of a verbally stated definition.

4. Name other relationships which could be classified under "rules" besides defined concepts.

   Other relationships include equal to, similar to, greater than, less than, before, and after.

5. How does problem solving differ from lower-order rules?

Problem solving differs in that it deals with devising a new answer to a new problem, rather than merely applying old rules.

III. Formative

A. 1. 5.20
2. 5.10
3. 6.20
4. 6.10
5. 3.00
6. 2.20
7. 2.30
8. 5.30
9. 4.20
10. 4.10
11. 1.23

B. 1. Discriminations
2. Concrete concepts
3. Rules
4. Problem solving
5. Problem solving
6. Problem solving

C.

Knowledge of Terms	Knowledge of Facts	Knowledge Rules and Principles	Skill in Using Processes and Procedures	Ability to Make Translations	Ability to Make Applications
Accounts payable ledger		Comparison between Schedule of accts. receivable & Accts. recievable control account	Post from cash disbursement journal.		Revise CRJ to meet needs Install a subsidiary ledger

UNIT IV
PREPARING INSTRUCTIONAL OBJECTIVES

OVERVIEW FOR UNIT IV

Unit IV continues the discussion of objectives. This time the focus is on preparing objectives for use in a course.

Specifying goals and objectives to clarify the purposes of instruction has become a useful and powerful tool in education. Statements of objectives serve as the first step in the development of improved curriculum materials and instructional techniques. They serve as guides to teachers in building evaluation instruments to appraise the degree of learning and the effectiveness of instruction. Readings in this unit will cover the reasons for stating goals, the differences between goals and objectives, and criteria for judging good objectives. There will also be examples of objectives and lists of verbs that are useful in constructing objectives.

This unit will also briefly present the Taxonomy of Educational Objectives: Affective Domain to complement the Taxonomy of Educational Objectives: Cognitive Domain presented in Unit III. The Affective Domain pertains to objectives dealing with attitudes, values, interests, appreciations, and social-emotional adjustments. It is presented because of its usefulness in planning and evaluating learning and instruction, but it will not be a major focus of the workbook.

As exercises for this unit, you will develop your own course goals and specific unit and class period objectives.

OBJECTIVES FOR UNIT IV

4.1 Distinguish between goals and objectives.

4.2 Analyze old tests to determine general course objectives.

4.3 Distinguish between good and poor objectives.

4.4 Write three to five objectives for each class period.

4.5 Classify each objective using the Taxonomy of Educational Objectives: Cognitive Domain.

4.6 Distinguish between affective and cognitive objectives.

REASONS FOR STATING SPECIFIC OBJECTIVES

1. When clearly defined objectives are lacking, there is no sound basis for the selection and designing of instructional materials, content, or methods.
2. A second important reason for stating objectives sharply has to do with finding out whether the objective has, in fact, been accomplished.
3. A third advantage of clearly defined objectives is that they provide students with the means to organize their own efforts toward accomplishment of those objectives.

4. The drafting of objectives causes one to think seriously and deeply about what is worth teaching, about what is worth spending time and effort to accomplish.

5. The objectives can serve as a spotlight to illuminate the worth of that existing instruction and they can provide a basis for improving it.

Source: Mager, Robert F. Preparing Instructional Objectives, 2nd edition Belmont, Cal. Fearon Publishers. 1975.

CHARACTERISTICS OF AN OBJECTIVE

An objective is a statement describing an instructional outcome rather than an instructional process or procedure. It describes results rather than the means of achieving those results. A course objective describes a desired outcome of a course. An objective tells what the learner is to be like as a result of some learning experiences. Whereas, a course description tells you something about the content and procedures of a course. It tells only what the course is about.

A usefully stated objective is one that succeeds in communicating an instructional intent to the reader. It is useful to the extent that it conveys to others a picture of what a successful learner will be like that is identical to the picture the objective writer had in mind. The most useful objective is the one that allows us to make the largest number of decisions relevant to its achievement and measurement.

A meaningfully stated objective is one that succeeds in communicating your intent. The best statement is the one that excludes the greatest number of possible meanings other than your intent.

WORDS OPEN TO MANY INTERPRETATIONS:

TO KNOW
TO UNDERSTAND
TO REALLY UNDERSTAND
TO APPRECIATE
TO FULLY APPRECIATE
TO GRASP THE SIGNIFICANCE OF
TO ENJOY
TO BELIEVE
TO HAVE FAITH IN
TO INTERNALIZE

WORDS OPEN TO FEWER INTERPRETATIONS:

TO WRITE
TO RECITE
TO IDENTIFY
TO SORT
TO SOLVE
TO CONSTRUCT
TO BUILD
TO COMPARE
TO CONTRAST
TO SMILE

Exercise 4.1

I. Read the following statements and determine if the statements are objectives or course descriptions. Write "O" for an Objective and "CD" for a Course Description.

___A. "A general survey of the organizing and administration of elementary and secondary school libraries, with emphasis on methods of developing the library as an integral part of the school, including functions, organization, services, equipment, and materials."

___B. In at least two computer languages, be able to write and test a program to calculate arithmetic means.

___C. Discuss and illustrate principles and techniques of modern computer programming.

___D. Be able to write a news article.

STATING THE GENERAL INSTRUCTIONAL OBJECTIVES

The first step in defining instructional objectives is to state the general learning outcomes we expect from our teaching. This step sounds simple enough, but most teachers find it difficult. They tend to focus on the teaching process, the learning process, or on the subject matter, rather than on the expected outcomes of instruction. Teachers also have some difficulty stating the objectives at a satisfactory level of generality; that is, of striking a happy medium between broad, undefinable statements and long, unmanageable lists of specific types of behavior. Let's first take a look at some of the common errors to avoid in stating instructional objectives.

Avoiding Errors in Stating General Objectives

One of the most common errors in stating objectives has already been considered -- that of describing teacher behavior rather than student behavior. Look at the following two objectives, for example, and note the difference in how they are stated. Which one most clearly indicates an instructional outcome?

1. Comprehends assigned reading material.
2. To increase the student's reading ability.

You should have had little difficulty in selecting between these two statements. The first statement contains an expected outcome of instruction. Later we would need to list a sample of the specific types of behavior that we are willing to accept as evidence that the student comprehends, but as stated, this is a good general outcome.

The second statement gives a less clear picture of the intended results of instruction. It also gives the psychologically unsound impression that it is the teacher who is going to do the increasing rather than the student.

Another common error is the stating of an objective in terms of the learning process rather than as a learning product. The following two statements will clarify the difference. Which one is stated as a product of instruction, i.e., an instructional outcome?

1. Gains knowledge of basic principles.
2. Applies basic principles to new situations.

If you selected the second statement, you are correct. This statement clearly indicates what the student can do at the end of instruction. The first statement emphasizes the gaining of knowledge (learning process) rather than the type of behavior that provides evidence that learning has taken place. Words like gains, acquires, and develops give away the fact that an objective is focused on the learning process rather than on the expected outcome of the learning experience.

In some cases where objectives are stated in terms of the learning process, the instructional intent is still fairly clear. This is frequently true for simple learning outcomes. For example, in the statement "develops skill in adding whole numbers," the learning outcome is quite obvious. On other cases, however, a single learning experience might contribute to any number of learning outcomes, none of which is readily apparent in the statement of objectives. For example, look at the following statement.

Learns symbols on a weather map.

This statement does clarify what the student is to learn, but it does not clarify the learning outcomes toward which the student should be directed. The teacher who wrote this statement might have in mind any one of the following learning outcomes:

Recalls the symbols used on a weather map.
Identifies the symbols on a weather map.
Interprets a weather map (using the symbols).
Constructs a weather map (using the symbols).

Predicts weather from a weather map (using the symbols).

It is obvious that the statement learns symbols does not indicate the intent of the instruction so clearly as the statements of learning outcomes listed above. Identifying the nature of the desired product provides greater direction for planning, carrying out, and evaluating the learning experiences.

Another common error in stating objectives is simply to list the subject matter to be covered. This error is readily apparent in a comparison of the following two statements. Which one is properly stated?

1. Principles of electricity.
2. Understands basic principles.

The correct answer is, of course, the second statement. The first statement consists of no more than a subject-matter topic. There is no indication of what the student is expected to do with regard to the principles of electricity. Is he to simply know them, or is he to understand or to apply them in some way?

The second statement could read understands principles of electricity, but there is some advantage in broadening the statement to include all types of principles covered in the instruction. The same outcome can then be used to indicate the expected reaction to any principle studied. When this is done, the specific types of behavior used to clarify what is meant by the word understands must, of course, be behaviorally oriented rather than content oriented. When complete, the statement of the objective and of the specific learning outcomes might appear as follows:

Understands basic principles.

1. States the principle in his own words.
2. Gives an example of the principle.
3. Distinguishes between correct and incorrect applications of the principles.

Note that the specific statements do not indicate what principles the student is to understand, but rather what behavior he is to demonstrate as evidence that he understands. By not including a reference to subject matter in statements of learning outcomes, you can develop a set of outcomes that is useful with various units of instruction throughout a course. Thus the subject matter in each unit of instruction will indicate the principles that are to be studied, and the learning outcomes will indicate the types of reactions the students are to make to the principles.

Another common error is to include more than one type of learning outcome in each general objective. Look at the following two statements. Which one contains a single outcome?

1. Uses appropriate experimental procedures in solving problems.
2. Knows the scientific method and applies it effectively.

Of course the answer is 1. The second statement includes both knows and applies as possible outcomes. It is better to have a separate statement for each because some students may know the scientific method (i.e., be able to describe it) but may not be able to apply it effectively. With separate statements, you can define each outcome in specific behavioral terms and thus determine how well each objective is being achieved.

In this section we have focused on the common errors to avoid in stating the general instruction objectives. These errors include stating the objectives in terms of (1) the teacher's performance, (2) the learning process, (3) the subject matter, and (4) a combination of two or more outcomes. These errors can be avoided by focusing attention on the student and on the type of performance he is expected to demonstrate at the end of instruction. Instructional objectives then, should be brief, clear statements that describe instructional intent in terms of the desired learning outcomes.

In addition to avoiding the common errors in stating instructional objectives, one of the most difficult tasks is to select the proper level of generality in stating each major objective.

Selecting the Proper Level of Generality

When developing a list of general instructional objectives for a course (or unit of course work), our aim is to obtain a list of goals to work toward and not a list of specific types of behavior to be attained by all students. To be sure, each general instructional objective will need to be defined further by a sample of the specific types of behavior that characterize each objective, but at this stage we are focusing only on the stating of the general objectives.

You may have noticed by now that each of the instructional objectives used in this chapter to illustrate properly stated learning outcomes began with a verb. The following verbs were used in these statements.

Applies.
Comprehends.
Knows.
Understands.
Uses.

These verbs provide a clue to the desired level of generality for our major objectives. They are specific enough to provide direction for instruction without overly restricting the teacher or reducing the instruction to the training level. They are also specific enough to be easily defined by a brief list of the types of behavior students are to demonstrate when the objectives have been achieved.

Let's look at a few sample statements that illustrate the problem of selecting a proper level of generality. Which one of the following statements represents the most general objective? Which one the most specific?

1. Communicates effectively in English.
2. Writes clear, effective English.
3. Punctuates sentences properly.

The first statement represents the most general objective. In fact, it is probably too general for a major objective because communication includes speaking, listening, writing, and reading. Each of these areas is general enough to provide a major goal by itself.

The most specific statement is 3, which might be a good statement of specific behavior to be listed under a more general objective, but it is probably too specific to be used as a general instructional objective. Thus, the second statement comes closest to the desired level of generality. It clearly indicates the general nature of the expected learning outcome, and it can be defined by a relatively short, clear list of specific types of behavior.

The degree of generality in the list of major objectives will, of course, vary with the period of instruction for which the list is being prepared. The objectives for an entire course will, of necessity, be more general than those for a unit of instruction within the course. For either purpose, however, choosing from eight to twelve general objectives will usually provide a list that is both manageable and suitable in terms of level of generality.

In summary, defining instructional objectives as learning outcomes is a somewhat difficult and frustrating task. The first step is to state the general instructional objectives as clearly and precisely as possible. Use the following suggestions as a guide to facilitate this procedure.

1. Begin each general instructional objective with a verb (See verb list). Omit such unnecessary refinements as "the student can..." or "the student has the ability to..."
2. State each objective in terms of student performance (rather than teacher performance).
3. State each objective as a learning product (rather than in terms of the learning process).
4. State each objective so that it indicates terminal behavior (rather than the subject matter to be covered during instruction).
5. State each objective so that it includes only one general learning outcome (rather than a combination of several outcomes).
6. State each objective at the proper level of generality, that is, at a level of generality that clearly indicates the expected learning out come and that is readily definable by specific types of student behavior. Stating from eight to twelve general objectives will usually suffice.

Source: Gronlund, N.E. Stating Objectives for Classroom Instruction. 2nd ed. New York. Macmillan. 1978.

USING THE TAXONOMY OF EDUCATIONAL OBJECTIVES

(From Bloom)

TABLE II Examples of General Instructional Objectives and Behavioral Terms for the Cognitive Domain of the Taxonomy

Illustrative General Instructional Objectives	Illustrative Behavioral Terms for Stating Specific Learning Outcomes
Knows common terms Knows specific facts Knows methods and preocedures Knows basic concepts Knows principles	Defines, describes, identifies, labels, lists, matches, names, outlines, reproduces, selects, states
Understands facts and principles Interprets verbal material Interprets charts and graphs Translates verbal material to mathematical formulas Estimates future consequences implied in data Justifies methods and procedures	Converts, defends, distinguishes, estimates, explains, generalizes, gives examples, infers, paraphrases, extends, predicts, rewrites, summarizes
Applies concepts and principles to new situations Applies laws and theories to practical situations Solves mathematical problems Constructs charts and graphs Demonstrates correct usage of a method or procedure	Changes, computes, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, shows, solves, uses
Recognizes unstated assumptions Recognizes logical fallacies in reasoning Distinguishes between facts and inferences Evaluates the relevancy of data Analyzes the organization structure of a work (art, music, writing)	Breaks down, diagrams, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, points out, relates, selects, separates, subdivides.
Writes a well organized theme Gives a well organized speech Writes a creative short story (or poem, or music) Proposes a plan for an experiment Integrates learning from different areas into a plan for solving a problem Formulates a new scheme for classifying objects (or events, or ideas)	Categorizes, combines, complies, composes, creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, writes
Judges the logical consistency of written material Judges the adequacy with which conclusions are supported by data Judges the value of a work (art, music, writing) by use of external standards of excellance	Appraises, compares, concludes, contrasts, criticizes, describes, discriminates, explains, justifies, interprets, relates, summarizes, supports

Exercise 4.2

Collect all of your mid-term and final exams. Rearrange the test items so that similar items, ideas, or concepts are together. Now analyze them and your topical outline and list approximately ten general objectives for your course. This will meet Objective 4.2.

SPECIFIC OBJECTIVES

Gronlund was describing very general course objectives. They are the backbone of the course and should be kept in mind at all times.

However, it is also useful to have much more specific objectives. These help the instructor to focus on what he intends to accomplish in a given class period. A useful guide for these is to have one objective for each fifteen minutes, or three of five objectives per class period. This is only a rough guide, and you may find a slightly different level of specificity more useful.

Most of Gronlund's suggestions for writing general course objectives are just as valid for specific class objectives. Remember to state each objective so that it indicates student behavior which can be described as an end product, and so that it indicates only one such behavior.

These objectives will differ only in their level of specificity. In his last example, Gronlund chose "Writes clear, effective English," as the proper level of generality. For our purposes here that is much too general. "Punctuates sentences properly" is better. Better still, given the time frame, is "Uses proper end punctuation."

Following are some examples of specific objectives from different disciplines.

Accounting 102

12.1 To define FICA expense and who pays for it.
To define unemployment tax expense and who pays for it.
To define withholding income tax and who pays for it.

Biology 126

1. Define digestion as a chemical and mechanical process.
2. A) Identify and state the functions of the organs of the alimentary canal: mouth, pharynx, esophagus, stomach, small intestine, large intestine, and rectum.
   B) Identify the accessory glands of digestion: liver, pancreas, and salivary glands (parotid, sublingual, submaxilary).
3. Label diagram of the digestive system. (Fig. 45-1, The Alimentary Canal, p. 255 in lab textbook).
4. Define and differentiate the following processes related to digestion: ingestion, deglutition, hydrolysis, emulsification, absorption, secretion, reabsorption, elimination, peristalsis, segmentation, defecation.

English 102

6.1 Given sets of general and specific words, mark the one that is general, with 85% accuracy.
6.2 Given a list of several concrete and abstract words, construct abstraction pyramids for each, with 85% accuracy.
6.3 Rewrite general sentences to make them more specific, with 85% accuracy.

Mathematics 103/112

Lesson 2: Operations with Integers and Decimals
OBJECTIVES DATE _______________

10. Add integers and decimals with 90% accuracy.
11. Subtract integers and decimals with 90% accuracy.
12. Multiply integers and decimals with 90% accuracy.
13. Divide integers and decimals with 90% accuracy.

14. Raise integers to whole number exponents.
15. Extract roots of integers.
16. Translate terms defining these operations into algebraic expressions.

Exercise 4.3

Indicate whether the following are good (G) or poor (P) objectives.

1. To develop a critical understanding of the operation of the target tracking console.
G___ P___

2. When the learner completes the program of instruction, he will be able to identify by name each of the controls located on the front of the target tracking console.
G___ P___

3. To develop an appreciation of music.
G___ P___

4. To be able to solve quadratic equations.
G___ P___

5. To be able to repair a radio.
G___ P___

6. To know how an amplifier works.
G___ P___

7. To be able to write a summary of the factors leading to the depression of 1929.
G___ P___

8. to understand the rules of logic.
G___ P___

9. To know the rules of football.
G___ P___

10. Given a list of 35 chemical elements, the learner will be able to recall and write the valencies of at least 30.
G___ P___

11. To understand the priniciples of salesmanship.
G___ P___

12. To be able to write three examples of the logical fallacy of the undistributed middle.
G___ P___

13. To be able to understand the meaning of Ohm's Law.
G___ P___

14. To be able to name the bones of the body.
G___ P___

15. To know the plays of Shakespeare.
G___ P___

ILLUSTRATIVE VERBS FOR STATING GENERAL INSTRUCTIONAL OBJECTIVES

Analyze
Apply
Appreciate
Comprehend
Compute
Create
Demonstrate
Evaluate
Interpret
Know
Listen
Locate
Perform
Recognize
Speak
Think
Translate
Understand
Use
Write

ILLUSTRATIVE VERBS FOR STATING SPECIFIC LEARNING OUTCOMES

Alter
Ask
Change
Design
Generalize
Modify
Paraphrase
Predict
Question
Rearrange
Recombine
Reconstruct
Regroup
Rename
Reorganize
Reorder
Rephrase
Restate
Restructure
Retell
Revise
Rewrite
Simplify
Synthesize
Systematize
Vary

COMPLEX, LOGICAL, JUDGMENTAL BEHAVIORS

Analyze
Appraise
Combine
Compare
Conclude
Contrast
Criticize
Decide
Deduce
Defend
Evaluate
Explain
Formulate
Generate
Induce
Infer
Plan
Structure
Substitute

GENERAL DISCRIMINATIVE BEHAVIORS

Choose
Collect
Define
Describe
Detect
Differentiate
Discriminate
Distinguish
Identify
Indicate
Isolate
List
Match
Omit
Order
Pick
Place
Point
Select
Separate

SOCIAL BEHAVIORS

Accept
Agree
Aid
Allow
Answer
Argue
Communicate
Compliment
Contribute
Cooperate
Dance
Disagree
Discuss
Excuse
Forgive
Greet
Help
Interact
Invite
Join
Laugh
Meet
Participate
Permit
Praise
React
Smile
Talk
Thank
Volunteer

LANGUAGE BEHAVIORS

Abbreviate
Accent
Alphabetize
Articulate
Call
Capitalize
Edit
Hyphenate
Indent
Outline
Print
Pronounce
Punctuate
Read
Recite
Say
Sign
Speak
Spell
State
Summarize
Syllabicate
Tell
Translate
Verbalize
Whisper
Write

"STUDY" BEHAVIORS

Arrange
Categorize
Chart
Cite
Circle
Compile
Copy
Diagram
Find
Follow
Itemize
Label
Locate
Look
Map
Mark
Name
Note
Organize
Quote
Record
Reproduce
Search
Sort
Underline

MUSIC BEHAVIORS

Blow
Bow
Clap
Compose
Finger
Harmonize
Hum
Mute
Play
Pluck
Practice
Sing
Strum
Tap
Whistle

PHYSICAL BEHAVIORS

Arch
Bat
Bend
Carry
Catch
Chase
Climb
Face
Float
Grab
Grasp
Grip
Hit
Hop
Jump
Kick
Knock
Lift
March
Pitch
Pull
Push
Run
Skate
Ski
Skip
Somersault
Stand
Step
Stretch
Swim
Swing
Throw
Toss
Walk

ARTS BEHAVIORS

Assemble
Blend
Brush
Build
Carve
Color
Construct
Cut
Dab
Dot
Draw
Drill
Fold
Form
Frame
Hammer
Handle
Hear
Illustrate
Melt
Mix
Mold
Nail
Paint
Paste
Pat
Pour
Press
Roll
Rub
Sand
Saw
Sculpt
Shake
Sketch
Smooth
Stamp
Stick
Stir
Trace
Trim
Varnish
Wipe
Wrap

DRAMA BEHAVIORS

Act
Clasp
Cross
Direct
Display
Emit
Enter
Exit
Express
Leave
Move
Pantomime
Pass
Perform
Proceed
Respond
Show
Sit
Start
Turn

MATHEMATICAL BEHAVIORS

Add
Bisect
Calculate
Check
Compute
Count
Derive
Divide
Estimate
Extrapolate
Extract
Graph
Group
Intergrate
Interpolate
Measure
Multiply
Number
Plot
Prove
Reduce
Solve
Square
Subtract
Tabulate
Tally
Verify

LABORATORY SCIENCE BEHAVIORS

Apply
Calibrate
Conduct
Connect
Convert
Decrease
Demonstrate
Dissect
Feed
Grow
Increase
Insert
Keep
Lengthen
Limit
Manipulate
Operate
Plant
Prepare
Remove
Replace
Report
Reset
Set
Specify
Straighten
Time
Transfer
Weigh

GENERAL APPEARANCE, HEALTH, AND SAFETY BEHAVIORS

Button
Clean
Clear
Close
Comb
Cover
Dress
Drink
Eat
Eliminate
Empty
Fasten
Fill
Go
Lace
Stop
Taste
Tie
Unbutton
Uncover
Untie
Unzip
Wait
Wash
Wear
Zip

MISCELLANEOUS

Aim
Attempt
Attend
Begin
Bring
Buy
Come
Complete
Consider
Correct
Crease
Crush
Designate
Determine
Erase
Expand
Extent
Feel
Finish
Fit
Fix
Flip
Get
Give
Grind
Guide
Hand
Hang
Lead
Lend
Let
Light
Make
Mend
Miss
Offer
Open
Pack
Pay
Peel
Pin
Position
Relate
Repeat
Return
Ride
Rip
Save
Scratch
Send
Serve
Sew
Share
Sharpen
Shoot
Shorten
Stake
Start
Stock
Store
Strike
Suggest
Supply
Support
Switch
Take
Tear
Touch
Try
Twist

MISCELLANEOUS CONTINUED

Develop
Discover
Distribute
Do
Drop
End
Hold
Hook
Hunt
Include
Inform
Lay
Present
Produce
Propose
Provide
Put
Raise
Shovel
Shut
Signify
Slip
Slide
Spread
Type
Use
Vote
Watch
Weave
Work

This list was developed by Calvin K. Claus, Psychology Department, National College of Education, Evanston, Ill., 1968.

Exercise 4.4

Write three to five objectives per class period for the learning units you developed in Unit II. This will meet objective 4.4.

Exercise 4.5

Now look at each of your objectives and classify them according to the Taxonomy of Educational Objectives: Cognitive Domain. Write the heading of the Category next to the objective.

*EXAMPLE: INTERPRETATION - The ability to comprehend and interpret with increasing depth and clarity various types of reading material.

AFFECTIVE DOMAIN

The Affective Domain is not the major focus of this course. However, we are including some information on this concept here because of its usefulness in planning and evaluating a course.

The Affective Domain deals with awareness, values, commitment, and the organization and revision of a value system. The list below describes some of the key words used in stating affective objectives. In addition, on the following pages, a condensed version of the affective taxonomy will describe this concept further.

"ACTION VERBS WITH PARTICULAR VALUE FOR THE AFFECTIVE DOMAIN" from Behavioral Objectives in the Affective Domain by Eiss and Harbeck, 1969.

accepts
adopts
advocates
annotates
argues (a position)
asks
attempts
challenges
chooses
consults
criticizes
defends
delays (response)
designs
disputes
evaluates
gathers (information)
investigates
joins
keeps (preserves)
obeys
objects (to an idea)
offers
organizes
participates
perserves
persists
praises
promotes
proposes
qualifies
queries
questions
recommends
rejects
seeks
selects
shares
sleeps
specifies
spends (money)
submits
subscribes
suggests
supports
tests
tries
visits
volunteers
weights (judges)
yawns

A Condensed Version
of the Affective Domain of The Taxonomy of Educational Objectives

1.0 RECEIVING (ATTENDING)

At this level we are concerned that the learner be sensitized to the existence of certain phenomena and stimuli; that is, that he be willing to receive or to attend to them. Because of previous experience (formal or informal), the student brings to each situation a point of view or set which may facilitate or hinder his recognition of the phenomena to which the teacher is trying to sensitize him.

Examples:

The student will tolerate viewpoints of the various ethnic groups in the class.

Students will watch while the instructor draws a diagram of a carburetor.

The student will recognize the importance of learning to add.

1.1 AWARENESS

Awareness is almost a cognitive behavior. Given appropriate opportunity, the learner will merely be conscious of something -- he takes into account a situation, phenomenon, object, or stage of affairs.

Examples:

Develops awareness of aesthetic factors in dress, furnishings, architecture, city design, good art, and the like.

Develops some consciousness of color, form, arrangement, and design in the objects and structures around him and in descriptive or symbolic representations of people, things, and situations.

1.2 WILLINGNESS TO RECEIVE

We are here describing the behavior of being willing to tolerate a given stimulus, not to avoid it. Given the opportunity to attend in a field with relatively few competing stimuli, the learner is not actively seeking to avoid it. At best, he is willing to take notice of the phenomenon and give it his attention.

Examples:

Attends (carefully) when others speak — in direct conversation, on the telephone, in audiences.

Appreciation (tolerance) of cultural patterns exhibited by individuals from other groups — religious, social, political, economic, national, etc.

Increase in sensitivity to human need and pressing social problems.

1.3 CONTROLLED OR SELECTED ATTENTION

We are concerned with a new phenomenon, the differentiation of a given stimulus into figure and ground at a conscious or perhaps semiconscious level — the differentiation of aspects of a stimulus which is perceived as clearly marked off from adjacent impressions. The learner is controlling the attention here, so that the favored stimulus is selected and attended to despite competing and distracting stimuli.

Examples:

Listens to music with some discrimination as to its mood and meaning and with some recognition of the contributions of various musical elements and instruments to the total effect.

Alertness toward human values and judgments on life as they are recorded in literature.

2.0 RESPONDING

This is the category that many teachers will find best describes their "interest" objectives. Most commonly we use the term to indicate the desire that a student become sufficiently involved in or committed to a subject, phenomenon, or activity that he will seek it out and gain satisfaction from working with it or engaging in it.

Examples:

The student will respond emotionally to poems discussed in class.

The student will volunteer for and actively participate in a class project.

The student will read assigned books on various subjects.

2.1 ACQUIESCENCE IN RESPONDING

We might use the word "obedience" or "compliance" to describe this behavior. Compliance is perhaps a better term than obedience, since there is more of the element of reaction to a suggestion and less of the implication of resistance or yielding unwillingly. The student makes the response, but he has not fully accepted the necessity for doing so.

Examples:

Willingness to comply with health regulations.

Obeys the playground regulations.

2.2 WILLINGNESS TO RESPOND

There is the implication that the learner is sufficiently committed to exhibiting the behavior that he does so not just because of a fear of punishment, but "on his own" or voluntarily.

Examples:

Acquaints himself with significant current issues in international, political, social, and economic affairs through voluntary reading and discussion.

Acceptance of responsibility for his own health and for the protection of the health of others.

2.3 SATISFACTION IN RESPONSE

The additional element beyond the "willingness to respond" level is that the behavior is accompanied by a feeling of satisfaction, an emotional response, generally of pleasure, zest, or enjoyment.

Examples:

Enjoyment of self-expression in music and in arts and crafts as another means of personal enrichment.

Finds pleasure in reading for recreation.

Takes pleasure in conversing with many different kinds of people.

3.0 VALUING

Behavior is categorized at this level if the learner displays the behavior with sufficient consistency in appropriate situations that he comes to be perceived as holding a value. Viewed from another standpoint, the objectives classified here are the prime stuff from which the conscience of the individual is developed into active control of behavior. This category will be found appropriate for many objectives that use the term "attitude" (as well as, of course, "value"). An important element of behavior characterized by Valuing is that it is motivated, not by the desire to comply or obey, but by the individual's commitment to the underlying value guiding the behavior.

Examples:

The student will initiate action for improvement of student government.

The student will be willing to form and express judgments about assigned read ing material.

When asked (anonymously) if chemistry is worthwhile or a waste of time, the student will indicate that it is worthwhile.

3.1 ACCEPTANCE OF A VALUE

At the level we are describing here, the student is both sufficiently consistent that others can identify the value, and sufficiently committed that he is willing to be so identified.

Examples:

Continuing desire to develop the ability to speak and write effectively.

Grows in his sense of kinship with human beings of all nations.

3.2 PREFERENCE FOR A VALUE

Behavior at this level implies not just the acceptance of a value to the point of being willing to be identified with it, but also that the individual is sufficiently committed to the value to pursue it, to seek it out, to want it.

Examples:

Assumes responsibility for drawing reticent members of a group into conversation.

Deliberately examines a variety of viewpoints on controversial issues with a view to forming opinions about them.

Actively participates in arranging for the showing of contemporary artistic efforts.

3.3 COMMITMENT

The ideas of "conviction" and "certainty beyond a shadow of a doubt" help to convey further the level of behavior intended. The student tries to convince others and seeks converts to his cause.

Examples:

Devotion to those ideas and ideals which are the foundations of democracy.

Faith in the power of reason and in methods of experiment and discussion.

4.0 ORGANIZATION

As the learner successively internalizes values, he encounters situations for which more than one value is relevant. Thus necessity arises for (a) the organization of the values into a system, (b) the determination of the interrelationships among them, and (c) the establishment of the dominant and pervasive ones.

Examples:

The learner will weigh monetary reward against personal preferences as to life style and fulfillment when considering a job.

The learner will conscientiously devote sufficient time to self-paced modules to keep up with the syllabus time schedule.

4.1 CONCEPTUALIZATION OF A VALUE

The additional element beyond valuing

is the quality of abstraction or conceptualization. This permits the individual to see how the value relates to those that he already holds or to new ones that he is coming to hold.

Examples:

Attempts to identify the characteristics of an art object which he admires.

Forms judgments as to the responsibility of society for conserving human and material resources.

4.2 ORGANIZATION OF A VALUE SYSTEM

Objectives properly classified here are those which require the learner to bring together a complex of values, possibly disparate values, and to bring these into an ordered relationship with one another. Ideally, the ordered relationship will be one which is harmonious and internally consistent. This is, of course, the goal of such objectives, which seek to have the student formulate a philosophy of life. In actuality, the integration may be something less than entirely harmonious.

Examples:

Weighs alternative social policies and practices against the standards of the public welfare rather than the advantage of specialized and narrow interest groups.

Develops a plan for regulating his rest in accordance with the demands of his activites.

5.0 CHARACTERIZATION BY A VALUE OR VALUE COMPLEX

At this level of internalization the values already have a place in the individual's value hierarchy, are organized into some kind of internally consistent system, have controlled the behavior of the individual for a sufficient time that he has adapted to behaving this way, and an evocation of the behavior no longer arouses emotion or affect except when the individual is threatened or challenged.

5.1 GENERALIZED SET

The generalized set is a response to highly generalized phenomena. It is a persistent and consistent response to a family of related situations or objects. It may often be an unconscious set which guides action without conscious forethought. The generalized set may be thought of as closely related to the idea of an attitude cluster, where the commonality is based on behavioral characteristics rather than the subject or object of the attitude. A generalized set is a basic orientation which enables the individual to reduce and order the complex world about him and to act consistently and effectively in it.

Examples:

Readiness to revise judgments and to change behavior in the light of evidence.

Judges problems and issues in terms of situations, issues, purposes, and consequences involved rather than in terms of fixed, dogmatic precepts or emotionally wishful thinking.

5.2 CHARACTERIZATION

This, the peak of the internalization process, includes those objectives which are broadest with respect both to the phenomena covered and to the range of behavior which they comprise. Thus, here are found those objectives which concern one's view of the universe, one's philosophy of life, one's Weltanschauung -- a value system having as its object the whole of what is known or knowable. As the title of the category implies, these objectives are so encompassing that they tend to characterize the individual almost completely.

Examples:

Develops for regulation of one's personal and civic life a code of behavior based on ethical principles consistent with democratic ideals.

Develops a consistent philosophy of life.

SOURCE: Krathwohl, D.R.; Bloom, B.S.; and Masia, B.B. Taxonomy of Educational Objectives. Handbook II: The Affective Domain. New York: David McKay, 1964.

Exercise 4.6

Indicate whether the following are Cognitive (C) or Affective (A) objectives.

____ 1. To identify prefixes and suffixes.

____ 2. To compute hospitalization costs.

____ 3. To identify the moods in classical music he admires.

____ 4. To match sentence patterns.

____ 5. Respect for the basic rights of human beings.

____ 6. To state the definition of percentile rank.

____ 7. To follow the rules and regulations of the U.S.

____ 8. To find pronouns and antecedents.

____ 9. To listen for rhythms in a musical selection.

____10. Calculate the mean for group frequency distributions.

FORMATIVE - UNIT IV

GIVEN BELOW ARE TWO CHARACTERISTICS OF A STATEMENT OF INSTRUCTIONAL OBJECTIVES.

A. IDENTIFIES THE BEHAVIOR TO BE DEMONSTRATED BY THE STUDENT.
B. INDICATES A STANDARD OR CRITERION OF ACCEPTABLE PERFORMANCE

ARE THESE CHARACTERISTICS PRESENT IN EACH OF THE OBJECTIVES BELOW? FOR EACH OBJECTIVE BELOW, CHECK WHETHER EACH OF THESE CHARACTERISTICS IS PRESENT.

A - B 1. The student must be able to understand the theory of evolution. Evidence of understanding will be obtained from a written essay on evolution.

A - B 2. The student is to be able to complete a 100-item multiple-choice examination on the subject of Marine Biology. The lower limit of acceptable performance will be 85 items answered correctly within an examination period of 90 minutes.

A - B 3. The student must be able to correctly name each item depicted by each of a series of 20 blueprints.

A - B 4. To demonstrate his ability to read an assembly blueprint, the student must be able to make the item depicted by the blueprint given him at the time of examination. Students will be allowed the use of all tools in the shop.

A - B 5. During the final examination, and without references, the student must be able to write a description of the steps involved in making a blueprint.

A - B 6. The student is to be able to draw his service revolver and fire five rounds (shots) from the hip within a period of three seconds. At 25 yards, all rounds must hit the standard silhouette target; at 50 yards, he must hit with at least two of his five rounds.

A - B 7. The student must know well the five cardinal rules of homicide investigation.

A - B 8. The student must be able to fill out a standard accident report.

A - B 9. The student must be able to write a coherent essay on the subject "How to Write Objectives for a Course in Law Appreciation." Students may use all references noted during the course, as well as class notes. Student must write his essay on paper provided by the examiner.

A - B 10. Beside each of the following psychological principles, the student must be able to write the name of the authors of experiments on which the principle is based (list of principles appended).

A - B 11. Given a list of objectives, the learner should be able to evaluate each.

A - B 12. To list the important characteristics of branching and linear self-instructional programs.

A - B 13. The student is to be able to name and give an example of each of six programming techniques useful for eliciting a correct response. To be considered correct, items listed by the student must appear on the handout entitled "Programming Techniques" issued by the instructor during the course.

A - B 14. To develop logical approaches in the solution of personnel problems.

HERE IS A RATHER POORLY STATED OBJECTIVE:

THE STUDENT MUST BE ABLE TO UNDERSTAND THE LAWS PERTAINING TO CONTRACTS.

INDICATE WHETHER THE FOLLOWING TEST SITUATIONS WOULD HAVE TO BE CONSIDERED APPROPRIATE FOR TESTING WHETHER THE OBJECTIVE HAD BEEN ACHIEVED.
APPROPRIATE (A) NOT APPROPRIATE (NA)

A - NA 15. The learner is asked to write the name of each of the justices of the Supreme Court.

A - NA 16. Given a contract with certain legal terms circled, the student is asked to write a definition of each of the circled terms.

A - NA 17. Given a legal contract and a list of contract laws, the learner is asked to indicate which of the laws, if any, are violated by the wording of the contract.

A - NA 18. The student is asked to answer 50 multiple-choice questions on the subject of legal contracts.

WHICH OF THE TEST SITUATIONS BELOW WOULD BE APPROPRIATE FOR ELICITING THE KIND OF BEHAVIOR BY WHICH YOU COULD TELL IF THE STUDENT REACHED THE OBJECTIVE?

OBJECTIVE: GIVEN A PROPERLY FUNCTIONING AUDIOMETER OF ANY MODEL, THE STUDENT MUST BE ABLE TO MAKE THE ADJUSTMENTS AND CONTROL SETTINGS NECESSARY PRIOR TO THE CONDUCT OF A STANDARD HEARING TEST.

A - NA 19. List the steps, in the proper order, for setting up a audiometer for use.

A - NA 20. Proceed to the audiometer on Table 5 and set it up so it can be used to administer a standard hearing test.

A - NA 21. Describe the steps followed in the conduct of a standard hearing test.

A - NA 22. Discuss the role of the audiometer in the hearing clinic.

INDICATE WHETHER THE FOLLOWING ARE COGNITIVE (C) OR AFFECTIVE (A).

____ 23. To appreciate the richness of Shakespeare's language.

____ 24. To rearrange given research topics from the most general to the most specific.

____ 25. To define a cash dividend.

ANSWERS

I. Exercise 4.1

A. CD
B. O
C. CD
D. CD

II. Exercise 4.3

1. Poor
2. Good
3. Poor
4. Poor
5. Poor
6. Poor
7. Good
8. Poor
9. Poor
10. Good
11. Poor
12. Good
13. Poor
14. Good
15. Poor

III. Exercise 4.6

1. C
2. C
3. A
4. C
5. A
6. C
7. A
8. C
9. C
10. C

IV Formative Quiz

1. A
2. B
3. A and B
4. A
5. A and B*
6. A and B*
7. Neither
8. A and B*
10. A and B*
11. B*
12. A
13. A and B
14. Neither
15. Not Appropriate
16. Not Appropriate
17. Appropriate
18. Appropriate
19. Not Appropriate
20. Appropriate
21. Not Appropriate
22. Not Appropriate
23. A
24. C
25. C

*THE CRITERION OF PERFORMANCE COULD BE STATED MORE EXPLICITLY.

UNIT V

CONSTRUCTING FORMATIVE EVALUATIONS

OVERVIEW TO UNIT V

Unit V describes the role of formative evaluation in Mastery Learning, and the incorporation of evaluation techniques into your own Mastery Learning course.

Mastery Learning requires two types of evaluations: formative and summative. Formative evaluation provides an ongoing appraisal of the degree of student learning of specific learning tasks on one hand, and the effectiveness of instruction on the other. Formative evaluation is most effective when used by students and teachers in directing their activities toward the achievement of course goals and objectives. Summative evaluation appraises the extent to which students have attained the general course objectives and is used primarily to provide bases for a course grade. An A grade usually indicates the student has mastered the course goals and objectives. Both summative and formative evaluations are critical components of Mastery Learning.

This unit requires you to develop a formative evaluation for each of the learning units in your course. This requirement usually demands expertise in writing items for objective tests, because they are the most common technique used for gathering evidence of student achievement. Although other forms of evaluation may be equally or more effective (e. g., evaluating a student's ability to apply course material in a real situation), objective tests are usually more efficient without sacrificing too much in effectiveness. Therefore, part of this unit will be a review of writing objective test items.

OBJECTIVES FOR UNIT V

5.1 Distinguish between good and poor objective test items.
5.2 Write one objective test item for each class period objective.
5.3 Construct one formative evaluation for each unit of your course.
5.4 Set the criterion level for mastery on each formative evaluation.

WRITING OBJECTIVE TEST ITEMS

Objective test items for your formative evaluations can take many forms. Some of the most common include:

1) Short answers,
2) True/false,
3) Multiple-choice, and
4) Matching.

These items are good for measuring the student's knowledge of terms, facts, rules, and principles. Properly constructed, they can also measure the student's ability to make translations or applications. They are especially useful because they can be quickly and accurately graded and returned to the class.

Below are some guidelines which will help you write objective test items. They have been compiled from a number of sources. Pleases remember that these are guidelines only. If these are suggestions that you disagree with, first analyze them. (For example, "Base each item on a statement which is absolutely true or false," does not mean that you should avoid all questions which are matters of opinion, but merely that these are not the best choices for true-false questions). If you still disagree with any of the guidelines, please feel free to rely on your own experience and judgment instead.

Designing the Test

1. Write each item so that it tests the students on one of the objectives for the unit; make sure that the items are directly relevant to the specific learning outcomes desired.
2. Match the vocabulary level and the degree of difficulty to the level of the class.
3. Keep the test items simple, readable, and clear.
4. Make sure that the directions for each item are clear and definite.
5. Avoid unimportant details.
6. Avoid trick questions.
7. Write each item so that it is free from irrelevant material which might prevent students from answering correctly.
8. Do not slip the answer into the question.
9. Do not supply the answer to another item on the test with your own clues.
10. Write the test item in the positive form wherever possible.
11. Write each item so that it has one, and only one correct answer.
12. Keep related test items together.
13. Try to arrange the test items in an ascending order of difficulty.

Writing Short-Answer Items

1. State the item so that the answer is limited to a number, word, or brief phrase.
2. Make the answer blanks equal in length (to prevent the student from using length as a clue).
3. For numerical answers, indicate the degree of precision expected (e.g., two decimal points).
4. Do not omit so many words in a fill-in-the-blanks item that it is difficult for a student to determine what is being asked.
5. Remember that the answer to a short-answer item may have a synonym or a similar answer which is also correct. (For example, the answer to "The author of Silas Marner is ______," could be either George Eliot or her real name, Mary Ann Evans).

Writing True/False Items

1. Write true/false items only when they are more appropriate than other item types (i.e., only two possible alternatives).
2. Base each item on a statement which is absolutely true or false.
3. Avoid statements which are partly true and partly false.
4. Write each item so that it is free from qualifiers (some, most, usually), absolutes (all, never, none), and ambiguous words (may, might, could) which might give students clues.
5. Keep the true and false statements approximately equal in length and number (to reduce correct guesses).

Writing Multiple-Choice Items

1. Write a stem which presents a single, definite problem.
2. Make the alternatives similar in form and grammatically consistent with the stem.
3. Write alternatives that are plausible to the non-achiever (use common errors and misconceptions).
4. Avoid grammatical, verbal, and length-of-response clues.
5. When using the negative in a direction, underline and/or CAPITALIZE it to call the students' attention to it.
6. Keep the alternatives brief; put all of the common wording in the stem.
7. Arrange the alternatives in numerical or logical order whenever possible.
8. Whenever possible, avoid the alternative "none of the above" and "all of the above."

Writing Matching Items

1. Write directions which clearly indicate the basis for matching and whether or not the responses may be used more than once.
2. Keep the material in the lists homogeneous.
3. Keep the lists relatively short.
4. Make the list of responses longer or shorter than the list of premises.
5. Place the responses on the right and in logical order (alphabetical or numerical).

Exercise 5.1

Write G next to the test items which are good and P next to the ones which are poor. This will help you meet Objective 5.1.

True-False

____ 1. Freezing weather is not infrequently unknown in Southern California.

____ 2. A functioning heart may depend on diet.

____ 3. There is no hope for the pulp of a young tooth which has become partially inflamed.

____ 4. The Mona Lisa was painted by Michelangelo.

Multiple-Choice

____ 5. What led to the formation of the States Rights Party?
   a. Federal taxation
   b. The demand of the states for the right to make their own laws
   c. The industrialization of the South
   d. The corruption of many city governments

____ 6. Which method tests the student's ability to retrieve information intact from memory?
   a. Recall
   b. Recognition
   c. Relearning
   d. Synthesis

____ 7. A synonym for gaunt is
   a. ugly
   b. ill
   c. haggard
   d. aged

Exercise 5.2

Write one objective test item for each class period objective you constructed in Unit IV. This will fulfill Objective 5.2.

WRITING ESSAY TESTS

Some of the objectives we have for our courses cannot be measured by objective tests. For example, true/false quizzes can only test items which are unequivocally true or false. Many items are still under dispute by authorities and, therefore, could not be tested by the true/false method.

Essay test items are good for measuring this type of information and for measuring the higher levels of the taxonomy. Essay test items can measure knowledge of general information, understanding of basic principles, or ability to apply principles to unfamiliar situations. The best use of essays is for testing student's ability to discuss, summarize, criticize, compare, and evaluate information learned in the course.

While essay tests are fairly easy to construct, they are difficult to score because of subjective factors, such as students' writing ability and legibility of the answers. Experiments have shown that two equally competent instructors may vary by as much as forty points out of a hundred in scoring the same exam. The best solution is to prepare a scoring key ahead of time to be used when grading each response.

When writing an essay test, limit the problem so that everyone who reads the question will derive the same meaning from it. A good question asks for specific answers. For example, instead of saying, "Compare and contrast the administrations of Abraham Lincoln and Andrew Johnson," it is preferable to say, "Compare and contrast four major domestic policies of Abraham Lincoln and Andrew Johnson. Five points will be awarded for each major policy discussed thoroughly and accurately." Note these other examples of good essay items.

Good items:
List at least five reasons why protecting metals from corrosion is especially important in aircraft, and give a short justification for each reason. Each reason is worth one point; each justification is worth three points.

Compare and contrast Henri Matisse's use of color before, during, and ten years after the Fauvist movement. You will receive five points for each idea you adequately defend. You should refer to specific paintings to illustrate your points; you may examine a book of Matisse prints as you answer this question.

If you carefully construct an essay test, you will be able to answer "yes" to all of these questions.

1. Are all questions restricted to objectives not readily measured by other types of questions?
2. Does each question pose a specific problem adequately delimited in scope?
3. In most cases, do you use several brief essay questions, rather than one or two long ones?
4. Does each essay question indicate clearly and accurately the desired extent and depth of the answer?
   a. Does the question indicate how many reasons, examples, or arguments are expected for full credit?
   b. Do the directions indicate the type of answer that will receive full credit?

One way to minimize bias is to score essay tests item by item, rather than student by student. For example, read and score item 1 on every test paper. As you work, be sure you don't know which student's paper you are grading. Then shuffle the papers, score all answers to item 2, and so forth.

A second method of minimizing bias is to write a model answer for each question ahead of time. Using numerical scores to each item on the checklist. Then reread your essay question to be sure you have told students exactly what you want. Use this scoring key when you grade each paper.

SOURCE: The League for Innovation in the Community College. Teaching in the Community College: An Orientation. New York. HBJ Media Systems Corporation. 1981.

"Use of Formative Evaluation"

Benjamin S. Bloom

Formative test construction

After the unit is appropriately analyzed into content and behavior, the constructor of a formative evaluation instrument (teacher, evaluation expert, curriculum maker, or other professional) must determine which elements in the unit are important or essential and which are unimportant or useful only as background for the essential material. For example, in a chemistry unit, the name of the originator of an idea, the dates when he lived, or the country of his birth may be useful as interesting background for presenting the idea but may be of little cognitive importance in the unit. Such specific facts may be included in the specifications but dropped at the time of testing. The point is that not everything included in the specifications is of equal importance, and the curriculum maker, the teacher, or the formative evaluator must apply some judgment and draw on experience to determine what is essential in the unit and what is trivial — that is, what may be omitted without imparing the student's mastery of the unit.

General principles of formative evaluation test construction

The formative evaluation should include all the important elements in a unit as detailed by the table of specifications. Thus, if there are twenty-five important elements in the table, all twenty-five should be represented by one or more test items. This is in contrast with summative evaluation, where it is feasible, in the testing time available, only to sample the range of contents and behaviors outlined in a table of specifications.

The formative evaluation should include items at each of the behavior levels specified. Virtually the same subject matter may be included as a term, specific fact, rule, process, translation, and application, if all are included in the specifications. This means that the tester must clearly distinguish an item that appraises the student's knowledge of a term or fact from the item that determines whether or not he can translate an idea into a new form or whether he can apply a rule or principle to a new problem.

If there is a hierarchy in learning difficulty (see Gagne, 1965, 1968), then the responses of students to the test should reveal this hierarchy. That is, the test items for knowledge of specific facts or terms should be passed by more students than those for knowledge of rules and principles or skill in the use of processes. Also, the test items involving translation and application are likely to be more difficult, and thus to be passed by fewer students.

The items in the test may also form a hierarchy in that passing the lower-level item is necessary for the mastery of the higher-level item (if this is indicated by the specifications). The item analysis might then conform with a pattern such as this:

		Higher-level Items	
		Fail	Pass
Lower-level Items	Pass	35%	35%
	Fail	30%	0%

That is, if the lower-level item is necessary for success on the higher-level item, then those students who fail the lower item should also fail the higher item — none who fail the first should be able to pass the second (except by chance or guessing). On the other hand, it is possible for some of the students who pass the lower item to fail the higher one, if the lower item is necessary but not sufficient for mastery of the higher item. Appropriate item analysis procedures can be used to determine whether the hierarchy of items established by the table of specifications is in fact borne out by student performance. In an unpublished doctoral dissertation (1968), Airasian found that three-fourths or more of the student responses showed the pattern of correct and incorrect responses indicated in the specifications for a chemistry and an algebra unit.

One analysis of the formative evaluation test should be made in terms of mastery or non-mastery. We have used accuracy levels of 80 to 85 percent on each formative test as an indication of mastery. This is arbitrary, however, and individual teachers may want to set the score for mastery higher or lower. If the accuracy level is too high (95 to 100 percent), it is likely to be obtained by only a few students, and there will be little postive reinforcement for mastery for very many students. On the other hand, if the mastery level is too low (50 to 60 percent), then a large number of students may have the illusion that they have mastered the unit of learning when in fact they have made many errors.

Another type of analysis of formative evaluation tests should reveal to the students the errors they have made. We have found it useful to provide the student with an answer sheet on which he can mark his errors. The back carries a diagram in which he can indicate his mistakes so that he may see the relations among the items he has answered incorrectly. The value of such a diagram is that the student can trace the pattern of his errors in relation to the behaviors involved. He can also relate these errors to the content included by reference to the actual items in the test.

Where possible, the record of errors should be accompanied by a detailed prescription of the instructional materials (textbooks, workbooks, programmed instruction, films, and so forth) he should consult to correct the errors and strengthen his mastery of the unit under consideration. These remedial suggestions might appear on the front of the answer sheet, as outlined in Fig. 6-1. It is desirable to make the prescriptions. very specific with regard to pages to be read, films to be seen, and the like.

The use of formative evaluation by students

The most important value of formative evaluation, in our view, is the aid it can give the student in his learning of the subject matter and behaviors for each unit of learning. It is possible to have the large majority of students attain mastery of the subject if instruction is appropriately individualized. One step in individualizing instruction can be formative evaluation accompanied by a variety of materials and instructional procedures for the student to use in remedying the particular gaps in his learning of a specific unit.

The pacing of students

Probably the most effective use of formative evaluation is in pacing student learning. When subject matter is sequential in a course, that is, when leanring units 1 and 2 are prerequisites to subsequent units, it is of importance that the student master units 1 and 2 before 3 and 4, 3 and 4 before 5 and 6, and so forth. This is most evident in subjects like algebra, where the first three or four units of the subject are basic to everything that follows. In such a subject, poor learning of the early units is likely to result in poor learning of all ensuing ones.

In sequential subjects, formative evalution can set goals for student learning as well as a time schedule for each unit. There is some educational literature, summarized by Anthony (1967), Merkhofer (1954), and Stephens (1951), indicating that the frequency of quizzes and other testing, when accompanied by detailed feedback to the examinee, is related to the performance level of the students. One way in which this operates is by pressing students to put the appropriate effort into studying the subject for each of the periods covered by the quizzes. The student is always faced with conflicting demands on his time, and he is likely to postpone work and study where the demands are less urgent. If he anticipates a quiz or a progress test, he is likely to make the appropriate preparation before the test.

Thus formative evalution helps the student by breaking the entire learning sequence into smaller units and by pressing him to make more adequate preparation while he and others are learning a particular unit. Although pacing the students is of the utmost importance when the learning units form a hierarchical sequence, it is still of some importance for the student to learn in a scheduled way even if the units are not arranged hierarchically. Especially is this true when there is a great deal to be learned, so that students who postpone their study too long will be faced with an over whelming amount of material, usually too great to be learned well just before the final summative evaluation.

Reinforcement of mastery

It is difficult for students to determine whether their learning is satisfactory, particulary with an instructor and a subject new to them. For students who have achieved mastery or near mastery of a unit of learning, the results of the formative evaluation can be an effective reward or reinforcement. This is especially useful for providing the student with positive reinforcement over small units of learning. The repeated evidence of mastery is a powerful reinforcement which will help ensure that the student will continue to invest the appropriate effort and interest in the subject.

FORMATIVE EVALUATIONS

Formative evaluations are diagnostic tools used to let you and your students know what material they have learned and what they need to study more thoroughly. Even though formatives are usually short objective quizzes, other approaches can be used. For example, in a science class, students may be asked to conduct a lab experiment. You should give one formative at the end of each unit with items written to cover the content shown in that unit's Table of Specifications/list of objectives. You should also arrange test items from simple to complex.

Formative quizzes do not count towards the student's grade. However, they are scored and returned to the student as soon as possible. By giving Certificates of Mastery (see Figure 5.1) or a similar recognition of mastery to students who meet your pre-determined level for mastery, you can use the formative process to improve learners' academic self-concept.

THE SAMPLE FORMATIVE QUIZZES WHICH FOLLOW REPRESENT THE FOLLOWING AREAS:

BIOLOGY

ENGLISH

MATHEMATICS

SAMPLE FORMATIVE QUIZ

Biology 101
Formative Test A

R. Gallagher
Loop

Unit V

Choose the one best answer in the following questions and blacken in that letter on your Answer Sheet.

1. Characteristics common to all living things are:
    a. movement, metabolism, structure
    b. structure, homeostasis, growth
    c. structure, metabolism, reproduction, homeostasis
    d. movement, reproduction, complex structure
2. Which statement best defines a hypothesis?
    a. a conclusion based on an experiment
    b. a new observation of scientific importance
    c. a controlled experiment
    d. a tentative explanation of something that must be tested
3. Modern classification systems not only utilize structure as basis for grouping organism but also:
    a. size b. color c. growth rate d. blood chemistry
4. When electrons are equally shared in a compound such as water, the bonding is:
    a. ionic b. polar c. covalent d. hydrogen
5. A ph of 9.0 means the number of hydroxyl ions is:
    a. greater than the number of hydronium ions
    b. less than the number of hydronium ions
    c. equal to the number of hydronium ions
6. The elements C, N, O, H are common to the molecular structure of:
    a. proteins b. lipids c. carbohydrates
7. Ability of the body to maintain a constant internal environment is:
    a. metabolism b. homeostasis c. respiration d. irritability

8. The chemical properties of elements are most closely related to:
   - a. the total number of neutons in their atoms
   - b. their abundance in cells
   - c. the electron number in the outer orbital of their atom
   - d. whether they are inorganic or organic

9. Which of the following factors would not be included in Darwin's support of evolution?
   - a. struggle for existence
   - b. variation among individuals
   - c. natural selection
   - d. use and disuse

10. Enzymes increase (catalyze) chemical reactions by:
   - a. taking part in the reaction and being chemically changed
   - b. providing energy to the reaction
   - c. fitting the substrate and breaking or forming new chemical bonds
   - d. destroying the substrate

SAMPLE FORMATIVE QUIZ

ENGLISH 102

Formative Test

Mr. W. Ibbs
Malcolm X College

Unit I: Rhetoric Defined

NAME ______________________________

DATE ______________________________

CLASS ______________________________

Carefully read the directions and questions. Answer all of the questions, even if you have to guess. Even though the test will not count in the course grade, the results will indicate how well you've mastered the objectives.

1. Rhetoric is defined as
   - A. The correct pronunciation of all the words in sentences
   - B. The correct use of words to form correct sentences
   - C. The most effective use of the most effective words to form the most effective message
   - D. The most effective style for the author's purpose.

2. Language is defined as
   - A. A system of arbitrary words organized into sentences and paragraphs that a social group uses to write out its thoughts, etc.
   - B. A system of arbitrary auditory and/or visual symbols that a social group uses to transmit its thoughts, etc.
   - C. A system of arbitrary marks that a social group uses to transmit its thoughts, etc.

3. Mark the most important difference between the spoken and written forms of a language, from the point of view of the writer. More than one may be correct.

___ A. Speaking involves sounds that are heard, while writing involves marks that are seen.

___ B. Unlike writing, speaking involves a fact-to-face situation so that the listener can ask questions if he or she doesn't understand.

___ C. Speakers, unlike writers, have gestures, facial expressions, and tone of voice to help communicate the message.

___ D. While speakers can use gestures, facial expressions, and tone of voice in addition to words, writers are limited to only marks on paper or similar media.

4. The following paragraph is guilty of what error in organization?
In rock music there is a distinct and almost overpowering beat. There is not a single beat characteristic of music today, but each song has an easily audible rhythm. As you listen to a song, your foot usually starts to pick up the beat. Nowhere are you likely to find a more varied kind of music. Performers with as different styles and musical interests as James Brown and Elvis Presley have felt at home with rock.
This paragraph is weak in:
___A. Unity
___B. Coherence
___C. Emphasis
___D. Word choice
___E. Completeness

5. What is the probable audience of the following?
Good Americans may, as the British playwright Oscar Wilde repeated, go to Paris when they die. But while they still live and can eat solid food, they should head for Lyons, the capitol of French cuisine, the gourmet's Rome. There, and in nearby towns, on a peninsula lapped by the Rivers Rhone and Saone, 280 miles southeast of Paris, the serious food lover will find the highest concentration and the most highly developed food culture in the Western World.
The probable audience is
___A. People who enjoy good food
___B. Students in a gourmet cooking class
___C. Seasoned travelers with enough money to "live it up"
___D. Young professionals who are beginning to make enough money to think about foreign travel.

6. What is the probable purpose of the following?
Why Self magazine? Very simply, there was no fitness magazine for women — until now. Fitness is America's number 1 enthusiasm and this exuberant concern for body and mind is what this new magazine will focus on. An extraordinary spirit and energy are emerging in women today. Fitness is the fuel. We have acquired a strong appetite for the full experience of life — the exhiliration of the outdoors, the challenge and success of professional work, the honest enjoyment of sex. Self magazine will be a guide to the vitality we need to do all the things we want to do.
The author's probable purpose is to
___A. Explain that there is a need for Self.
___B. Convince women to buy Self magazine.
___C. Convince companies to advertise in Self.
___D. Convince women of the importance of fitness.

7. Evaluate the following paragraph for form and content.
The one institution today which openly practices the discouragement of ideas is the church. Essentially it tells its members not to think. From birth to death it controls its members intellectual environment.
___A. Both content and form are acceptable.
___B. Both content and form are faulty.
___C. Content is acceptable, but form is weak.
___D. Form is acceptable, but content is weak.

8. Indicate whether the following statements are facts, inferences, or judgments.
Roots was written by the English playwright William Shakespeare.
___A. Fact ___B. Inference ___C. Judgment
Blood flows through the human body in tubes called blood vessels, the total length of which is estimated at 60,000 to 100,000 miles.
___A. Fact B. Inference ___C. Judgment
There are no worthwhile programs on TV.
___A. Fact ___B. Inference ___C. Judgment
From the look of those dark, heavy clouds, we'll have rain in a few minutes.
___A. Fact ___B. Inference ___C. Judgment

SAMPLE FORMATIVE QUIZ

Richard Williams
Malcolm X College

Mathematics 111 Unit 3 Polyonomials (A)

1. Identify the following polynomials as a monomial, binomial, or trinomial:

   a. $p(x)= 6x^2-7$ b. $p(x)= 7x^2-7x + 9$

2. Given $P(x)= 7x^3-6x + 9$:
   a. The degree of the second term is ______________
   b. The numerical coefficient of the second term is ______________

3. Given $P(x)= 3x^3-6x^2 + 4$
   a. Compute $P(-2)$ b. Compute $P(2/3)$

4. Given $P(x)= 14x^2 + 8x - 9x^2$ the like terms are ____________________
5. Add:

   a. $1/8x^2 + 5/18x^2$ b. $(x^2+ 9x - 5) + (3x^2 + 2x + 2)$

6. Subtract: $(.07x^3-.4x^2 + .33) - (.02x^3-7x^2-.4)$
7. Multiply:

   a. $(5x^2) (-7x^3)$ b. $(18/35\ x^3) (14/30\ x - 10)$
   c. $.6x^2(.3x^3 + 5x - .02)$

8. Divide:

   a. $-30x^7/10x^2$ b. $.75x^8/ .5x^{-2}$

9. How do you multiply a nomial times a polynomial?

Exercise 5.3

Construct one formative evaluation for each unit in your course. This will meet Objective 5.3.

SETTING THE CRITERION LEVEL FOR MASTERY

Setting the criterion level for mastery test is usually at the discretion of the teacher. According to Gronlund (1973), "the best we can do is arbitrarily set a standard and then adjust it up or down as experience dictates." He suggested the following steps to illustrate the process of setting the criterion level for mastery.

1. Start by arbitrarily setting the level of mastery for each item type as follows:

Short - answer	80% correct
Multiple - choice	85% correct
True - false	90% correct

2. If a higher level of mastery is necessary for effective learning at the next stage of instruction, increase the required "percentage correct." For simple computational skills, for example, complete mastery might be set as the goal.

3. If a higher level of mastery is necessary for safe performance in some activity, increase the required "percentage correct." Before a student is permitted to operate dangerous laboratory or shop equipment, for example, complete mastery of the procedure and of the safety precautions might be required.
4. If a test, or subtest, is relatively short, increase the required "percentage correct." This allows for the smaller, and thus less dependable, sample of behaviors.
5. If experience in teaching the material indicates that a higher or lower level of mastery is desirable, adjust the "percentage correct" as indicated. The objectives for an instructional unit may be easier or more difficult to attain than was originally anticipated, for example. Or, it may be found that because of repetition of the knowledge and skills in the next unit of study, a high level of mastery at the initial stages of instruction is unnecessary.

Exercise 5.4

Set the criterion level for mastery for each of your formative evaluations. This will fulfill Objective 5.4.

FORMATIVE - UNIT V

INFORMATION: 1
In writing items, it is urgent that we adhere to certain ideas of form. It behooves us to use simple, sensible, neat, accurate, readable, clear communication. Keep the question "in one piece"; separate the body of the item from the distractors with two spaces; separate the distractors from each other with one space.

QUESTION: 1
If you were a student, which form would you rather have presented to you?
(A) the most usable formx oforganzed information was once called the Codex. What is it now called?
(B) The most Usabel of orGanized information was once xxx called the Codex What is it now called ---------.
(C) The most usable form of organized information was once called the codex. What is it now called?

INFORMATION: 2
There are several kinds of tests, and it is probable that one form is better than another, depending on many factors. It is a good idea to try to use the test which is most suitable to the manner and form and content desired in the answers relative to the subject matter. To put this more simply, if one were to ask the question, "Is it raining?" ___ the sensible answer to be expected is the choice of "yes" or "no." This is called an objective type. If a question were posed, "What do you think about the weather outside?" ___ then the answer would be naturally of an essay nature, which is a subjective type. So, when you make a group of queries, attempt to make then in tune with the form of the answers which you expect.

QUESTION: 2
Which of the following three queries is most appropriate for short factual-type answers?
(A) Who, in what year, discovered America?
(B) What is the Mason-Dixon line?
(C) A piece of land surrounded by water is called an ____________.

INFORMATION: 3
Remember, as teachers, you must keep in mind the range of difficulty which any one test is expected to cover; don't forget that although you know and understand much more than any one test covers, you must continously bear in mind that a test is a specific thing, and its component questions should retain a constant degree of difficulty.

QUESTION: 3

Two of the following items seem to be equally difficult. Pick the other one.

(A) Write down the names, in chronological order, of the presidents of the United States.

(B) Name all the metallic elements.

(C) Write the now famous Einstein formula of the theory of relativity and comment on its usefulness in space travel.

INFORMATION: 4

Unimportant details are to be avoided in testing. Not only that, unimportant details should be avoided in teaching. When items are constructed, the writer of them should keep in mind that he is trying to test the students' retention of facts or thoughts or ideas which have value. if a detail is unimportant, that should be the end of it.

QUESTION: 4

Which of the following three is "least likely to succeed" as a test item?

(A) What is the middle name of Harry S. Truman?

(B) Which is the biggest state in the Union?

(C) Which is the smallest state in the Union?

INFORMATION: 5

Objective tests do not lend themselves to items whose answers are under dispute. Let's say we have a seventh grade class and we are dealing with factual questions about presidents. Remember that the students should not be confronted with items about which authorities are in disagreement.

QUESTION: 5

Pick out the least disputable question of the three.

(A) Who was the tallest president we ever had?

(B) Who was the most popular president we ever had?

(C) Who was the greatest president we ever had?

INFORMATION: 6

All of us tend to use more words than are necessary or even desirable. In the writing of items, clarity is imperative, and since an excess of words usually develops into unclear directions, it is necessary to guard against all excess word-baggage.

QUESTION: 6

One of the following three items has the most clarity and is the last least encumbered with words. Which is it?

(A) He was walking along, kicking the leaves, which sometimes bounded into the weaving of his sweater, which he swung it at his side; in this part of the country it was to early for snow. What was the season of the year?

(B) It was October the first in Chicago. What was the season of the year?

(C) Although it was somewhere between summer and winter, and although the weather had been unpredictable, and even if snow were forthcoming soon, it was almost impossible to tell from one day to the next, whether or not Jack's head-cold was getting better or worse, even though he always wore a heavy coat, protecting himself from the low temperatures which might come, or making him perspire when they didn't. What was the season of the year?

INFORMATION: 7

There is no sense in writing questions or instructions or items which contain traps or any other pitfalls with which to bedevil students. If you want to test your students for alertness, do so; but do not combine this type of test with one given for other purposes.

QUESTION: 7

Two of the three below contain such traps. Select the other.

(A) When it snows, the temperature is always 32°F.
True ( ) False ( )

(B) Have you stopped beating your wife?
Yes ( ) No ( )

(C) A true vacuum contains no air.
True ( ) False ( )

INFORMATION: 8

Care must be used in the wording of questions. Sometimes in our efforts to help the student we accidentally slip the answer into the question.

QUESTION: 8

In the following, pick out the question which does not reveal its own answer.

(A) When Robinson was in solitary confinement, was he allowed to talk to his cellmate?
(B) What was the sentence imposed upon Robinson, who was finally executed?
(C) How long was Robinson in jail?

INFORMATION: 9

Use care in the manner in which you word items. If you are not careful, you may inadvertently supply the correct answer to another item with your own clues.

QUESTION: 9

Pick out the item below which supplies the correct answer for the other two questions.

(A) A 90-degree angle is called a _______________
(B) The opposite angle of a right angle is called a _______________
(C) A circle contains four equal _______________

INFORMATION: 10

Sometimes we construct a sentence or question that is so involved that the student (who may know the answer easily) has difficulty in attempting to figure out the question itself. This is unfair to the student, to the test, and to the one who makes out the test. Remember that we are not trying, purposely or accidentally, to outwit the student. Regardless of how difficult the answer may be, the wording of the question should be simple — as simple as possible.

QUESTION: 10

Pick out the least confusing of the following questions.

(A) Is it not untrue that the purchase of Alaska was not popular?
(B) Was the purchase of Alaska, at the time, considered to be popular?
(C) Although the purchase price of Alaska was less than $10,000,000, the vast expanse of ice and snow (and unknown territory) was, at that time, thought to be, by many, a waste of money; the division of opinion about this so-called unecessary expenditure of American tax money led to much controversy in the halls or the legislature. Although it is agreed now that this was a great bargain for the amount of the money paid, do you, looking back at history, think that the purchase could be considered to be (from the viewpoint of one who lived at the time) a popular buy?

INFORMATION: 11

Indefinite questions are undoubtedly the most puzzling ones to a student. As you know, lack of clarity and lack of communication are items to be avoided in any educative process.

QUESTION: 11

Notice the two vague, indefinite items of the three following. Pick out the one item that is definite.

(A) About when did the industrial revolution start?
(B) How many miles is it around the earth at the equator, either in nautical or statute miles?
(C) In inches, how long is 3 yards, 2 feet, and 1 inch?

INFORMATION: 12

Keep items uncomplicated. Do not double test any one item; that is, do not include two points, one in the stem and one in the completion.

QUESTION: 12

Select the item whose answer confines itself to one segment.

(A) Muscles ___________, and never ___________.
(B) Muscles pull, and never ___________.
(C) Muscles ___________ pull, and ___________ push.

INFORMATION: 13

For the sake of organization, and for the sake of the thinking processes, it is better to keep related items together. The student attempting to answer any set of questions will perform better if the questions involved are grouped in sections which are identifiable. He will be able to do what is expected of him better if he can direct his mind to one area at a time. If he is forced to reset his thinking every time a new question is posed, it will be unfair to him, and consequently, to the teacher.

QUESTION: 13

Of the following three items, one is far removed from the other two in subject area. Pick it out.

(A) John's father told him to buy enough barbed wire for a three-strand fence around a one-acre plot. Approximately how many feet of wire did John need to get?

(B) David has seven-eights of the amount of money he started with. That, plus the $14.00 he earned, amounted to $98.00; how much money did David start with?

(C) In order for a community to become industrialized, the two most necessary available natural products are coal and ___________.

INFORMATION: 14

After the items to be included in a test are constructed by the tester, he should present them beginning with item one, and ascend to the most difficult item. Using his best judgment, he starts with what he considers to be the easiest item, and works toward the last. The reasoning behind this is that the tester should strive to give each and all students, as much as possible, a taste of success in the beginning, thereby eliciting from those tested the maximum performance.

QUESTION: 14

Assuming that the following are in incorrect order of presentation to the student, which one should be placed first in order to correct this error?

(A) John was very happy with his new bike.
(There are ___________adjectives in this sentence.)

(B) John, who had just gotten his new bike, was very happy.
(What is the name applied to the words set off by the two commas?)

(C) John has a new bike.
(This is a simple sentence; what word is the subject?)

INFORMATION: 15

The multiple-choice test is made up of items each of which presents two or more responses, only one of which is correct or definitely better than the others. Each item may be in the form of a direct question, an incomplete statement, or a word or phrase. The value of multiple-choice tests in diagnosis depends upon the skillful selection of the incorrect choices presented in the items. In teacher-made tests we should use four or five choices in each item. Whenever possible use at least four choices. However, increasing the number of plausible choices tends to reduce the guessing factor. Here is a good example from tasks around the household.

Example:

The spoon should be placed
(1) at the top of the plate.
(2) at the left of the fork.
(3) in the spoon holder.
(4) at the right of the knife.

QUESTION: 15

How many choices are suggested as best in constructing multiple-choice items in tests?

(A) We may have three to six choices in each item of our tests that we prepare.

(B) It is best to use your own judgment as to the number of choices.

(C) For the most part it is best to use four or five choices in constructing items.

INFORMATION: 16

When preparing test items make all optional responses grammatically consistent. For example, if the verb is singular, avoid plural responses, and vice versa. It is advisable to use the same grammatical form in the question or questions that follow the information that you have given in the frame. Remember to keep all parts of the item in the same grammatical form. You should avoid the use of a or an as the final word before the list of choices, as these words are definite clues to the correct answer. If all choices do not go with one or the other of these articles, place the proper article at the beginning of each choice.

Example:

Poor: Joe picked an _______ off the tree and ate it.

Better: Joe ate the ________ which he picked off the tree.

QUESTION: 16

When constructing test items, what should we remember about grammatical structure in the item and any part of the item?

(A) The inconsistency in the grammatical construction of test items is of little importance.

(B) The grammar of all the items can be what the instructor thinks is desirable to use.

(C) At all times the grammatical structure should be in agreement with all parts of the item.

INFORMATION: 17

Be sure that there is one and only one correct or clearly best answer. It hardly seems necessary to specify that a multiple-choice item must have one and only one right answer, but in practice this is one of the most pervasive and insidious faults in item writing. If you will think the question out that you are given below, I'm sure you will sail right through it.

QUESTION: 17

Which answer below is the only answer that is correct concerning the information material above?

(A) On occasion it is permissible to have two answers alike and give credit for both answers.

(B) Only one correct answer should be written into a multiple-choice test.

(C) It is all right at times to have two answers that are correct, although one is slightly more indicative of the right answer and that should be considered as the correct response.

INFORMATION: 18

In constructing items if any nonsense choices are used the real thinking situation is reduced to fewer choices. Therefore, each item should be constructed with great care. Special attention should be given to the incorrect options such as distracters, decoys, or foils. All of the choices of answers should be as plausible as possible. Avoid trick statements. These are usually statements which appear to be true but which are really false because of some inconspicuous word or phrase.

Example:

(1) "The Raven" was written by Edgar Allen Poe.
(2) "The Raven" was written by Edgar Allan Poe.

QUESTION: 18

The choice of answer to your test items should best fit into which of the following categories?

(A) In writing your choices to an answer, keep them as plausible as possible.

(B) It is permissible to use as many distracters as you desire.

(C) The silly-choice answer is good to have in any testing program.

INFORMATION: 19

Where possible, keep the choices short. The items should be so carefully worded that the response required is as brief as possible, preferably a single word, number, symbol, or at most a short phrase. This will objectify and facilitate scoring.

QUESTION: 19

Choose the response below that would best qualify according to the information above. For which army was Robert E. Lee the commanding general?

(A) The Confederate States of America under the presidential leadership of Jefferson Davis.

(B) The army that represented the Southern States.

(C) The Condederate Army.

INFORMATION: 20
Remember that you should use the negative sparingly in the stem of an item. It is usually desirable to emphasize the positive aspects of knowledge rather than the negative aspects. However, there are times when it is important for the student to know the exception or to be able to detect errors. For these purposes a few times with the words "not" or "except" in the stem may be justified, particularly when overinclusion is a common error for students. When a negative word is used in the stem of an item, it should be underlined and/or CAPITALIZED to call the student's attention to it.

QUESTION: 20
Pertaining to the above information, which multiple-choice type question would be best?

(A) What city on the Mississippi was put under seige and starvation by Ulysses S. Grant?
(B) Which one of the leaders of the Revolutionary War did not want the Articles of Confederation changed?
(C) Which man did not sign the Declaration of Independence?

INFORMATION: 21
Avoid making the correct response consistently longer or shorter than the others. This tendency will make the right answer conspicuous by making it more complete or by qualifying it more than the other answers makes it stand out. In the correct response guard against using the same words or phrases that occur in the question or statement. Stay away from grammatical clues to the answer expected.

Remember if the response varies in length the student will have a clue to the answer.

QUESTION: 21
What has the length in the response to do with test-item writing?

(A) Varying the length of answers tends to confuse the pupil and give the more able student greater mental exercise.
(B) Lengthy responses are good and will lead the student to think for himself.
(C) The tendency to make the response consistemtly longer or shorter will give the student a clue to the right answer.

INFORMATION: 22
Try to arrange the responses so that correct ones occur in random order. The students are then less likely to detect any regularly recurring patten in the sequence of responses. In other words, avoid any pattern in the position of the correct responses. If you make number (1) the correct choice twice, then number (2) the correct choice twice, and then number (3) the correct choice, and continue in such pattern, the student will see the pattern, the student will see the pattern and just put the answers down without reading the questions. Keep the choices of the correct responses in about equal numbers.

QUESTION: 22
What is the best practice in the arrangement of correct responses?

(A) The best method is to arrange responses in random order.
(B) The arrangement of responses has very minute effect on the outcome of tests.
(C) If the arrangement of responses is so placed that the student can make a high score, it is the best way.

ANSWERS

A. Exercise 5.1

1. Poor; statement includes three negatives: not, infrequently and unknown.
2. Poor; the word may makes the statement ambiguous.
3. Poor; the phrase no hope is both absolute and negative
4. Good
5. Poor; the phrase in response b "of the states for the right" is a word clue. Response b is also much longer than the other three possibilites.
6. Good
7. Good

B. Formative

1. C
2. C
3. C
4. A
5. A
6. B
7. C
8. C
9. B
10. B
11. C
12. B
13. C
14. C
15. C
16. C
17. B
18. A
19. C
20. A
21. C
22. A

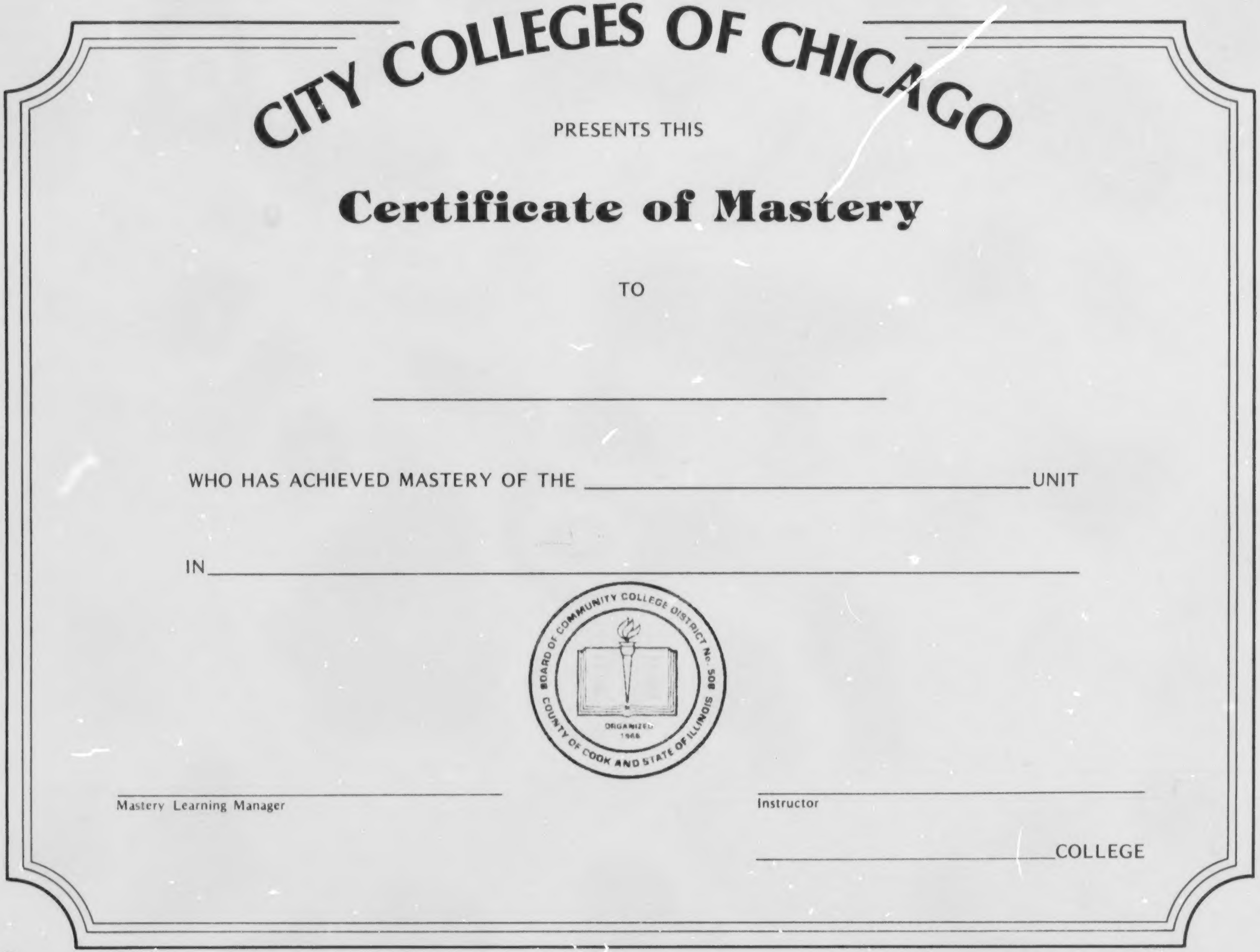


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Fig. 5.1

UNIT VI

DEVELOPING CORRECTIVE LEARNING PROCESSES
AND
QUALITY OF INSTRUCTION

OVERVIEW FOR UNIT VI

The research on Mastery Learning strategies reports that the two components most responsible for making Mastery Learning successful are the use of feedback and the use of correctives. In Unit V of the workbook you developed formative evaluations for each learning unit to provide both the students and yourself with feedback on the learning process. In this unit you will focus on the development of correctives to provide alternative methods for communicating learning material to students and to provide additional time and practice where it is needed.

Generally, correctives are alternative learning experiences that correspond to formative quiz items the student has missed. Corrective processes enable students who have specific learning difficulties to overcome these difficulties. Since no single group instructional method can be optimal for all students, corrective processes are employed to individualize instruction for each student. In addition to insuring accomplishment of learning objectives for a particular unit, correctives also insure that all student have the prerequisites needed for the next unit in the course. This increases the chances of successful learning on subsequent units. With proper use of correctives the majority of your students can master the course material.

Since a variety of correctives is critical to meeting individual student learning needs, this unit will provide you with corrective techniques such as alternate textbooks and small-group study sessions. You will build a minimum of one corrective procedure for each objective in your course. When time permits, you should diversify the types of correctives that your course offers.

Feedbacks, correctives, cues, participation, and reinforcement are all part of what Bloom means by quality of instruction. Mastery Learning research has found that quality of instruction can explain up to 25% of the variability in learning. If quality of instruction can be made optimal for the series of learning tasks that make up your course, especially for the earlier ones, you will increase student achievement in your course. In this unit you will review this research.

OBJECTIVES FOR UNIT VI

6.1 Write one corrective for each formative test item.
6.2 Summarize the results of research on correctives and quality of instruction.
6.3 Describe the four main elements which affect the quality of learning.

DEVELOPING UNIT CORRECTIVES

The purpose of unit correctives is to provide for the individualization of instruction. Various types of correctives are: alternate textbooks, workbooks, flash cards, audiovisual aids and materials, token economies, academic games, group affective exercises, programmed instruction, tutoring, and small-group study sessions.

Research conducted on correctives indicates that the most effective corrective is frequently tutoring, particularly peer group tutoring. This form of corrective is used less often because of the problems of managing it effectively. The Mastery Learning Project strongly encourages you to consider this form of corrective.

Four other types of correctives typically used in the City Colleges are: alternate textbooks, small-group study sessions, PLATO (Computer Assisted Instruction), and videotapes. An overview of these correctives follows, along with samples of correctives constructed by teachers in the City Colleges of Chicago.

Alternate Textbooks, Tutors And Small-Group Study Sessions

ALTERNATE TEXTBOOKS. Alternative textbooks are what we call "individual presentational" correctives. They are used to give the student a different slant on the textbook material relevant to each unit's objectives.

For each important element in the unit we identify alternative treatments in other textbooks. In selecting these alternative treatments we try to obtain presentations of each content element that are different form one another and from the textbook's presentation. We then note the pages in each alternative next where one might find a treatment of the particular content elements in the unit.

TUTORING. Tutoring is also an "Individual presentational/involvement corrective." The able tutor seems to present problematic materials to the students in a variety of modes almost effortlessly. And he slides easily from involving him in another when learning encounters a snag.

In our work, we have tended to use peers as tutors. We simply solicit students who mastered particular material to teach that material to classmates who are having difficulty with it. However, some teachers with whom we have worked have preferred to use former students as tutors. That is, they have encouraged cross-age tutoring rather than same age tutoring. And still other teachers with whom we have worked have used adults (e.g., retired persons, parents, volunteers, etc.). Whether you use classmates, former students, or adults, suffice it to say that tutoring is a powerful, all-purpose corrective.

SMALL-GROUP STUDY SESSIONS. Small-group study sessions are considered to be a "group presentation/involvement" strategy. They are essentially a sophisticated group approach to tutoring.

In these sessions, three to four learners get together to discuss their learning problems. We try to be sure that each student in a group has very different learning problems than his partners. This way each student has learned some material that he can teach to the other members in the group; he can tutor his peers as well as be tutored by them.

In a typical session, the students first identify the diagnostic-progress test items with which they have had difficulty. They then go over each of these items as follows. One student who has answered the item of interest correctly will explain the material tested by the item and give reasons for choosing the answer he did choose. The floor is then open for discussion about the material tested by the item and about the correct answer to the item.

*Excerpts from: Block, James H. and Anderson, Lorin W. "Developing Unit Correctives." In Mastery Learning in Classroom Instruction. New York: Macmillian Publishing Co., Inc., 1975.

PLATO: The Computer Tutor

Chris Dimas, Director
Computer Supported Instruction
City College of Chicago

PLATO (which stands for Programmed Logic for Automated Teaching Operations) is a nationwide computer network geared to teaching and research. Over a thousand terminals, located at schools and universities throughout the country, are linked by telephone lines to the central computer at the University of Illinois in Champaign-Urbana. PLATO currently provides over 7,000 hours of instruction in over 90 subject areas.

The City Colleges of Chicago system has the largest number of terminals of any university or college system except the University of Illinois. CCC curently has over 165 terminals at all nine colleges in the system. In the past three years, over 100,000 PLATO sessions have been logged on CCC terminals annually.

Studies conducted at the City Colleges have found that students who used PLATO received higher grades than students who did not, which supports Bloom's theory of time-on-task as being an important determiner of student achievement. Furthermore, a majority of students indicated that they liked being able to learn at their own pace, liked avoiding the embarrassment of making mistakes in front of a group, and learned more in classes that used PLATO.

The PLATO terminal has a display panel (much like that of a TV set) on which text, drawings, and animations appear. Attached to the terminal is a standard typewriter keyset with additional keys which enables the user to communicate with the computer in two-way dialogue. PLATO usage does not require knowledge of computers and generally requires only a minimal typing skill.

Although there seems to be no single best way to use computers for instruction, the following is a survey of the main ways in which computers are used for instruction:

TUTORIAL. Students are taught a unit of study entirely by the computer.

DRILL AND PRACTICE. Students are taught a unit of study by the teacher; the computer provides drill materials until students reach a certain level of proficiency.

SIMULATION. Students who have been taught the fundamentals of a particular subject can apply this knowledge in a life-like simulation on the computer where they can gain experience yet avoid situations where the risks are too great, the time too long, or the logistics insurmountable. For example, a medical student or intern may be provided with a patient's symptoms and then be asked to make a diagnosis or prescription. After each prescription has been entered, the computer evaluates the patient and provides the student with feedback on the patient's progress.

COMPUTER-MANAGED INSTRUCTION (CMI). Students are directed to various computer materials and activities because of their performance on a pretest on a subject or unit. After studying the material, the students take a post-test on which they are graded. If they reach a certain criterion level, they can progress to the next unit; if not, they are provided an additional educational corrective via the computer. This process can usually be repeated until the appropriate level of achievement is reached. CMI and Mastery Learning appear to have many of the same ingredients.

COMPUTER PROGRAMMING. Students are taught how to write programs in order to solve problems encountered in their courses.

Computer-managed Instruction and drill and practice would both be useful as correctives for units. CMI can free the teacher from some of the time consuming and repetitious activities like administering, grading, and recording unit and summative quizzes and guiding the student to corrective material based on student performance.

Instructors at the City Colleges of Chicago who want to use PLATO to administer their formative quizzes or correctives should begin by contacting the PLATO project in the Center for the Improvement of Teaching and Learning. There is already a master list of computer materials, and it is very likely that the materials needed for correctives in any given course are already on the PLATO computer.

Audiovisual Techniques

Both audio and video materials can be used to provide correctives. These can take many forms, the most common of which is the taping of a class or lecture. Some teachers have also used audio or videotapes to review the formative quizzes.

These materials will permit the learner to stop the tape at any point or to repeat the same section any number of times. In our experience, students respond well to this approach. There are other uses as well. For example, a physics teacher may videotape an experiment. Or a history teacher may interview an authority in his field and use that interview as supplementary material.

These tapes do not have to be polished to be successful. A simple record of your material, made available to your students when they are able to study, will be a powerful tool. However, Herb Rosing, who used the Audio-Tutorial approach in his physical science classes at Loop College, suggests that the instructor use a more structured approach. Here is the procedure that works for him:

1. State the objective of the program.
2. Plan and list possible learning experiences that would guide the learner to achieve the objective(s).
3. Sequence the learning experiences.
4. Construct evaluation instruments.
5. Write a script for the presentation. (Rosing prefers using notes to a more detailed narrative to allow a less formal and more relaxed presentation).
6. Construct a study guide for the learner to use during the presentation.
7. Construct Appendix 1 - Correct Responses to Practice Exercises.
8. Construct Appendix 2 - Additional Practice Exercises.
9. Obtain "tangibles"-reference books, class handouts, copies of blackboard work, etc.-required by the program.
10. Rehearse program
11. Report program
12. Student-test program
13. Revise program.

A CCC faculty member who would like advice or guidance on the use of audio tapes as correctives can check with the audio-tutorial center in the Physical Science Department at Loop College. For assistance with video correctives, the instructor can see Ed Gorawski in the Center for the Improvement of Teaching and Learning.

SAMPLE CORRECTIVES ARE PRESENTED IN THE FOLLOWING AREAS:

Business
English
Reading
Biology
Mathematics

SAMPLE CORRECTIVE - BUSINESS 101

P.A. Armstrong-Instructor
Malcolm X College

Correctives I. Formative: A

IF YOU MISSED	RE-READ:	AND:
1.	p. 22-23	write the correcting sentence from the book
2.	p. 14	write the fundamental equation and circle the correct section
3.	p. 13	write the correcting sentence from the book
4.	p. 15	" " " " " "
5.	p. 12	" " " " " "
6.	p. 11	" " " " " "
7.	p. 18	write a sentence to correct this
8.	p. 27	write-out the illustration that shows this
9.	p. 27-28	write a sentence to correct this
10.	p. 8	write the equation
11.	p. 6	write the correcting sentence from the book
12.	p. 10	write accounts to show this affect
13.	p. 21-22	write a sentence to correct this
14.	p. 13	write the headings which are correct
15.	p. 11	write a sentence to correct this

1.) Multiple sources listed
2.) because several classes meet simultaneously.
3.) Review class notes and chapter 6, in Read to Succeed.
4.) Read Right pp. 153 to 183.
5.)
6. Studying a Textbook., F.L. Christ; Reading Interpretation in Social Science, Natural Sciences & Literature.
7. Map and Glove Skills Kit p. 34
Organizing & Reporting Skills Kit
"Notetaking & Outlining Unit"
"Making an Outline Unit"
Reading for Meaning, Books 6 thru 12
8.) Graph & Picture Study Skills Kit, table, circle, picture,
9.) bar, line graph units.
10.) RI in SS, NS and L. pp. 75-79, 80-89
11. Supportive Reading Skills, Adv. Level,
"Using an Index"
"Using a Table of Contents"
12. Study Skills Library R I in S S, N S, & L. pp. 108-110
"Reference Skills"
Lessons for Self-Instruction in Basic Skills
"Reference Skills" Series A & B
Listen & Think (tapes and workbooks) "Summarizing"
13. Listen & Think (tapes and workbooks) R I in S S, N S & L, pp. 68-70
"Recognizing Sequence"
"Recognizing Cause & Effect"
Specific Skill Series "Detecting the Sequence"
Levels 6 and Advanced
14. Review class notes and exercises.
15. Chapter 6 in Read to Succeed, review class notes
16.) Organizing & Reporting Skills Kit
) R I in S S, N S, & L, pp. 31-54
) "Notetaking & Outlining"
17.) Specific Skill Series "Getting the facts", Level F
18. Read to Succeed, p. 157
For review of essentials in preparing for and taking examinations
Lessons for Self-Instruction in Basic Skills
"Following Directions" Series E-F, G.
Supportive Reading Skills: "Understanding Questions," Adv. Level
"Predicting Paragraph Content": Reading for Meaning:
Specific Skill Series: "Following Directions," Level Adv., "Locating the Answer" Level F.

SAMPLE CORRECTIVE - BIOLOGY 101

Robbin Gallagher
Loop

Unit 1

Missed Problems	Read (Chapter and pages)	Do (section review) (pages and numbers)
1	1. 4	9. 1
2	1. 11 to 12	15. 2
3	2. 25 to 26	9. 2; 38. 2 and 3

4	3. 46 to 48	51. 3 and 4
5	3. 51	51. 7
6	3. 52 to 53	56. 2
7	1. 7	9. 5
8	3. 45	51. 1 to 3
9	2. 23 to 24	24. 4
10	3. 68 to 70	70. 5

SAMPLE CORRECTIVE - MATH 103

Correctives 2-A

Formative Test 2-A

Items	Objectives	Correctives
I	Determine absolute value for integers	Read Ex. 2-1, do problems even numbers
II	Identify operational symbols for adding.	Read Ex. 2-2 & Ex. 2-3 do problems even numbers
III	Subtraction of signed numbers	Read Ex. 2-4 & 2-5 do problems even numbers
IV	Multiplication of signed numbers	Read Ex. 2-6; do problems even numbers
V	Division of signed numbers	Read Ex. 2-7; do problems even numbers
VI	Evaluation with signed numbers	Read Ex. 2-8; do problems even numbers
VII	Identify symbols for adding, subtracting, multiplying & dividing signed numbers	Review for examination do problems with at least 80% success
VIII	Find the value of each of the following examples	Page 51, do problems 40, 42, 44, 46, 48
IX	Graph the integers on a line graph	Read Chapter review do problems 1, 2, 3, 4.
X	Chapter Review	Read and do problems 12, 14, 16, 18, 20

Exercise 6.1

Develop one corrective for each formative test item in each of your learning units. This will fulfill Objective 6.1.

TWO CORRECTIVE PROCEDURES USED IN MASTERY LEARNING

Each Mastery Learning strategy assumes that if someone is having learning problems on one segment of the instructional sequence, these problems should be cleared up before they impair future learning. Hence, each carefully monitors student learning over every segment of the instruction and periodically corrects problems as they develop.

But, while they agree on the need for correctives, different mastery approaches use different sorts of correctives. In Keller's Personalized System of Instruction, correction is typically accomplished by returning the student on to the original instructional materials and methods for the segment upon which he is having learning problems. In Bloom's Learning for Mastery strategy, it is usually accomplished by sending the student on to supplementary instructional materials and methods that teach the problematic subject matter in ways different from the original materials and methods.

The present research addresses two questions. First, does correction have a positive impact on students' learning? Second, does it matter how the correction is accomplished?

Forty-four students in an upper-level college historiography class were the subjects. Three separate instructional treatments were used to teach their course, and one-third of the students in the class were assigned each treatment.

The first treatment, the control treatment, was the traditional lecture/discussion approach. In this treatment, subjects attended 50-minute lectures three times a week during the quarter and read six required books.

The second treatment, the redirected study treatment, used the traditional plus a Keller-type correction procedure. Students were tested every two weeks and told which items they had answered correctly and which ones they'd missed. The prescription then directed the students to restudy and review the original reading materials and lecture notes for the previous two-week period.

The third treatment, the small-group study treatment, used the traditional approach plus a Bloom-type correction procedure. Students in this treatment were given the same diagnostic-progress tests bi-weekly as the redirected study group, but they had their tests returned during cooperative small-goup study sessions typical of Bloom-type mastery learning strategies.

It is important to note that, due to the constraints of the instructional setting, in neither correction treatment could students be formally required to use their respective correctives. Techniques for coping with this ranged from constant prodding, to asking the redirected study students for periodic self-reports on attempts to correct learning problems, to taking attendance at the small-group study sessions. While more formal procedures would have clearly been desirable, these informal procedures seemed to work quite well.

The students were measured by three means:

1) A take-home essay examination whose letter grade was converted to a number grade.
2) A 50-item multiple-choice achievement test, and
3) A 10-item Likert - type attitude scale . . . Mathematics subscale.

The analyses of variance based on these descriptive statistics indicated that correction had an effect on students' total achievement test scores that approached significance. But the analyses also suggested that perhaps one approach to correction had had a very different effect on student achievement than the other. The small-group study students achieved an estimated 2.26 more items correct than the control students, while the redirected study students achieved 2.19 fewer items correct than the control students.

In order to analyze why these differences took place, each student's total achievement test score into his sub-scores on the knowledge items and on the application items. This separation did show a difference.

In sum, if learning was measured in terms of the students' knowledge of the material taught, their final course grades, and their attitude toward history, then students who received correction periodically throughout the course did not learn more than students who received no correction. This was true regardless of whether correction was accomplished by returning the student to the original instruction (redirected study) or by sending him to different instruction (small-group study). But if learning was indexed in terms of the students' ability to apply materials taught, then students who received correction did learn more than students who received no correction, provided that correction was accomplished by sending the student to different instruction (i.e., small group study).

How then can the correction findings be explained? The most obvious explanation is that correction can have a positive impact on certain dimensions of student learning, but only if it is accomplished in a particular way. In particular, this study suggested that application of the course material could be significantly improved if students used a correction procedure which exposed them to supplementary instructional methods and materials rather than a one which required them to review and practice the original methods and materials.

It is hoped that future research would test this explanation using a wider variety of correction procedures and a number of dimensions of student learning. Such research might eventually make it possible to select correction procedures which, in combination with ordinary group-based instruction, are most powerful for promoting certain desired dimensions of student learning.

ADAPTED FROM:

Block, James H. and Tierney, Michael F. "An Exploration of Two Corrective Procedures Used in Mastery Learning Approaches to Instruction."

Exercise 6.2

Summarize the results of the research from "Two Correction Procedures Used in Mastery Learning."

QUALITY OF INSTRUCTION

There is little doubt that under normal school conditions the characteristics of students at the beginning of a series of learning tasks have far more effect on what they will learn than does the quality of instruction they receive.

If a learning task is carefully defined, analyzed, and evaluated, it is what it is, and the lack of requisite cognitive entry behaviors should make it impossible for a student to learn it to some criterion of mastery — no matter how good the quality of instruction on that learning task or how much time and perseverance the student gives to that learning task.

If, on the other hand, the learning task can be altered in a number of ways such that each alteration in the learning task requires different entry behaviors, then it is quite possible that students who lack cognitive entry behaviors for one form of the learning task may possess the entry behaviors for another form of the learning task. In such cases, students who can't learn under the one form may be able to learn under another form — if they possess the necessary entry behaviors for that form of the learning task.

Futhermore, it is possible that of the student acquires the necessary entry behaviors on his own — by special tutoring or help, or by the instruction initially shifting from the original learning task to the prerequisites for that task — the student may eventually learn the original learning task.

With affective learning behaviors, we are convinced that a very good quality of instruction may overcome negative initial affective characteristics so that the student can learn the particular learning tasks to a high level.

Stripped to its essentials, the quality of instruction has to do with the cues or directions provided to the learner, the participation of the learner in learning activity, and the reinforcement which the learner secures in some relation to the learning. Because much of school instruction is group instruction and because any attempt at group instruction is taught with error and difficulty, a feedback and corrective system must be also included in the quality of instruction. It is these four elements of instruction, cues, participation, reinforcement, and feedback/correctives which will be considered next.

Cues. Any learning includes some elements to be learned and some method of communicating cues to the learner about what he is supposed to do about them. These cues may be relatively simple, such as a sound or word to be related to a particular object, event, or activity. Although we appear to be suggesting that the cues begin the process, it should be obvious that instruction is not a simple progression from cues to each of the other aspects of instruction. The cues may be provided at many stages of the learning process, and the elements of instruction may be arranged in many different sequences; we can even imagine situations where they may occur almost simultaneously.

The cues include instruction as to what is to be learned as well as what the learner is to do in the learning process. There are many forms in which the cues can be presented. In most group instruction in the schools the major clues tend to be verbal in nature; that is, the student is directed by the teacher or by the materials of instruction to do certain things, to call something by given terms, to remember particular things in the form of words or sets of words, or to perform some complex cognitive or psychomotor process.

Not all cues need to take the verbal form. Some may be in the form of visual stimuli and patterns which are to be remembered or responded to in an appropriate way. Others may make use of other senses -- tactile, kinesthetic, olfactory. Cues may take the forms of models, observations of self or others, or demonstrations which the student is to reproduce in some way.

Cues vary not only in form, but also in strength and meaningfulness. The cues must be understood or comprehended if the student is to make use of them in his learning.

It is likely that cues which are easily understood in one form by some students may need to be expressed in other ways before they become meaningful to other students. Learners may differ in the extent to which they can learn from particular cues. If the only form in which cues are presented is verbal, it is likely that students who are most proficient or comfortable with verbal cues will learn most easily, while students who learn in other ways will be at a disadvantage. Similarily, if students who can learn best through mathematical, graphic, or other non verbal ways are presented with appropriate forms of cues, they are likely to learn more easily than they will with other forms.

Participation. A learner must do things with the cues to actually learn. The simple presentation of a set of cues to a passive learner is not likely to produce very much in the way of learning.

Teachers develop a variety of strategies for ensuring participation. They may focus on one child at at time, break a large group of students into smaller groups where each member of the small group must do something observable by the other members in the group, have each child go through selected steps of the process so it can be observed, secure evidence in the form of oral or written materials in some problem-solving situation, or have each student complete homework or other assignments. Unfortunately time and other limitations involved in teaching a group of learners make it difficult for the teacher to observe or ensure that each of the learners is actively participating in using the cues in the desired ways.

However, not all participation must be overt and observable. If the students are actively participating in a covert way, this may be as effective under some conditions as overt participation. It is likely that overt participation may be especially needed for young children to learn, while covert participation — if it can be ensured — is highly effective for older learners.

Reinforcement. Most learning theories are in agreement that learning is effective only when it is accompanied by reinforcement. While there is some question about the relative effectiveness of positive versus negative reinforcement, there is little question that reinforcement of some type is needed during or after each part of the learning process.

Teachers have long recognized the need for rewarding or reinforcing learning, and almost every teacher will be observed to use reinforcement during most learning sessions. However, teachers differ in the variety of reinforcements they use, in the frequency with which they use reinforcements, and in the amount of reinforcement they give to different individuals in their classes.

Reinforcers may be related to the individual's need for self-esteem. That is, the student must approve of himself, and any device, object, or expression which helps him to maintain or enhance his self-esteem can serve as a reinforcer.

Reinforcers need not be administered always by the teacher. They may be supplied by the social group or class of which the student is a member, by his peers and by other adults, including parents. Eventually, the student may be his own source of reinforcement. Also, the task to be learned can, under some conditions, become a source of reinforcement by itself.

It is likely that individual learners may need different types of reinforcers and even different amounts of reinforcement at various stages in the learning process.

Feedback/Correctives. In most school learning, instruction is provided to groups of students -- usually about thirty students in a group. Under these conditions, even the best use of cues, participation, and reinforcement must be differentially effective for individual learners. What is an excellent set of cues for one student may be less than ideal for another. The amount of participation that is optimal for one may be inadequate for another. The amount and type of reinforcement that is about right for one learner may be inappropriate for another. Whenever we have a group instruction, we are likely to provide well for some students and less well for others.

Some provision must be made for a way of determining the adequacy and appropriateness of cues, participation, and reinforcement for each learner and for altering or correcting these as needed for each individual student. The feedback/corrective procedure can help make these adjustments.

The feedback procedures typically consist of brief formative tests at the end of each learning task which indicate what the student has learned and what he still has to learn to attain mastery of the task.

The correctives are the suggestions as to what each student should review in the original or new instructional material, programmed instruction, special explanations in the form of sound cassettes, and additional workbooks and practice exercises. Additional instruction on particular ideas missed by the student are frequently given by other students, aides, or even by the teachers in some instances.

Stated another way, the primary emphasis in the corrective procedure is on alternative cues and additional time and practice. It is also possible that the corrective procedures may include additional reinforcement.

Studies have shown that, because they help tailor the class to the student's individual needs, the feedback/corrective process is the most effective of the variables affecting quality of instruction.

ADAPTED FROM:

Bloom, Benjamin S. Human Characteristics and School Learning. New York. McGraw-Hill. 1976. Chapter 5. "Quality of Instruction."

Exercise 6.3

Define each of the four variables of quality of instruction in a group instructional situation.

Formative Quiz - Unit VI

Choose the answer that does not apply:

1. The corrective process in mastery learning is designed to:
   - a. insure students clear up learning problems
   - b. insure students have the pre-requisites for sequential learning tasks
   - c. provide more time for learning in areas of difficulty
   - d. compensate for poor group instruction

Choose the best answer:

2. Which of the following corrective processes would research indicate is the most effective?
   - a. students reread course text passages corresponding to missed test items
   - b. students form a cooperative study group to discuss formative quiz answers and results
   - c students receive tutorial assistance in areas of difficulty
   - d. students are directed to alternate textbooks and reading materials for items missed on the formative quiz

Choose the best answer:

3. Which aspects of Mastery Learning strategies have research studies found are most successful in increasing student achievement?
   - a. using behavioral objectives
   - b. using the Taxonomy of Educational Objectives in planning your course
   - c. using feedback and correctives
   - d. altering group instructional techniques
4. Which of the following factors has the most impact on student achievement on a learning task?
5. Very good quality of instruction can overcome prerequisite cognitive entry behaviors.
   True ______ False ______
6. Very good quality of instruction can overcome initial affective characteristics.
   True ______ False ______
7. How does Bloom suggest that teachers overcome the lack of cognitive entry behavior?
   ____
   ____

   List the four characteristics of instruction that can be altered to provide optimal quality of instruction.
8. ____
9. ____
10. ____

11. ______________________________

12. Which of those four characteristics of instruction account for the most improvement in learning?

____

Corrective learning procedures focus primarily on two characteristics of quality of instruction. What are these two characteristics?

13. ______________________________

14. ______________________________

Name four kinds of correctives used at the City Colleges of Chicago.

15. ______________________________

16. ______________________________

17. ______________________________

18. ______________________________

Answers - Unit VI

A. Exercise 6.4
   1. Cues - ways of telling the student what will be expected of him in the learning task.
   2. Participation - ways, either overt or covert, in which the student takes an active part in the learning task.
   3. Reinforcement - ways in which the student gets approval for doing a good job or disapproval for doing a bad one.
   4. Feedback/correctives - ways in which both the teacher and the students can learn how well they are doing and the students can improve their mastery.

B. Formative
   1. d
   2. b
   3. c
   4. a
   5. false
   6. true
   7. restructuring learning tasks to require different cognitive entry behaviors.
   8. cues
   9. participation
   10. reinforcement
   11. feedback/correctives
   12. feedback and correctives
   13. altering cues
   14. providing more practice or participation
   15. small study groups
   16. alternate textbooks
   17. computer tutoring
   18. audiovisual aids

A SUMMARY OF GENERAL TYPES OF CORRECTIVES

Benjamin Bloom devised the following chart to show several types of correctives and to illustrate the ways in which they can best be used.

CORRECTIVES	INDIVIDUAL	GROUP	PRESENTATION	INVOLVEMENT
ALTERNATIVE TEXTBOOKS	X		X	
WORKBOOKS	X		X	
FLASHCARDS	X		X	
RETEACHING		X	X	
AUDIO-VISUAL* MATERIALS		X	X	
TOKEN ECONOMICS	X			X
ACADEMIC GAMES		X		X
GROUP* AFFECTIVE EXERCISES		X		X
PROGRAMMED INSTRUCTION	X		X	X
TUTORING	X		X	X
SMALL GROUP STUDY SESSIONS		X	X	X

*THESE CORRECTIVES MIGHT ALSO BE USED ON AN INDIVIDUAL BASIS IN SOME SITUATIONS.

Figure 6.1

UNIT VII

DEVELOPING FORMATIVE/CORRECTIVE/RETAKE CYCLES

OVERVIEW FOR UNIT VII

In the past two units you have constructed formative evaluations to assess the degree of learning and developed corrective learning tasks to enhance the level of learning attained through group instruction. In this unit you will develop formative/corrective/retake processes for your course. The unit will focus on the development of retake test items to assess the impact of correctives.

If the correctives are effective, then the student will pass an alternate test item representing the learning task which he did not master on the original formative evaluation. The first step in developing the retake process is writing an alternate parallel item for every original formative test item. These test items should reflect the same taxonomic level as the original test items.

The second step of the retake process is to develop the most effective and efficient way of implementing the retake process in your course. This involves developing classroom management techniques to monitor student progress in the formative/corrective/retake process. Implementing the formative/corrective/retake cycle involves:

a) administering the formative evaluation,
b) prescribing corrective learning tasks, and
c) assessing the effectiveness of the corrective.

Careful planning is essential if this process is to be effective and efficient. The teacher must decide when, during the class period, the formative evalution will be administered, how the corrective process wil be monitored, and under what conditions the retake will be given. CCC research has shown that effective implementation of this process will result in improved student performance and decreased attrition.

OBJECTIVES FOR UNIT VII

1. Write one alternate retake test item for each item on the formative evaluations.
2. Set standards of performance for the retake test.
3. Develop an action plan for students who do not reach mastery on the retake test.
4. Write a plan for implementing the formative/corrective/retake cycle in your course.

RETAKE TEST ITEMS

The retake test is a diagnostic tool which parallels the corresponding formative quiz to determine if the corrective has helped the student remedy the deficiencies revealed by the formative quiz. Parallel does not mean that the items on the retake are identical to the items on the corresponding formative but that the items are related to the same objective. Since each original formative quiz item is written to assess accomplishment of each unit objective, you should make sure that your retake test items assess mastery of each of these objectives. The retake test items should also assess behavior at the same taxonomic level as the original formative test items and the unit objectives.

The guidelines listed on pp. 5-1, 2 and 3 of Unit V for writing formative test items will be useful to you in developing retake test items. Before developing your retake test items, you should review the following pairs of formative and retake tests:

ACCOUNTING
BIOLOGY
ENGLISH
MATHEMATICS
READING

SAMPLE FORMATIVE QUIZ

ACCOUNTING 102
Donald Radtke
Daley

Formative Test 16-A   Student's name______________________________

Part I - fill in the blank - 2 points

1. Extraordinary items are transactions and events that are both unusual in nature and ___ ____________________in the operating environment of a business. p.547.

2. Retained earnings are appropriated or "earmarked" as a means of informing the stockholders that ____________________ . p. 543.

Part II - 4 points - p. 542

On the date interest was paid, a corporation had $3,000,000 of convertible bonds, on which there was $60,000 of unamortized discount. The bonds were convertible at the rate of 40 shares of the company's $15 per value common stock for each $1,000 bond, and on that date bondholders presented $100,000 of the bonds for conversion. In the space that follows give without an explanation the entry to record the conversion.

Part III - 7 points

Following are several account names with each account name preceded by an identifying number. Below the names are 7 transactions of a corporation. Indicate the accounts debited and credited in recording each transaction by placing the appropriate account identifying numbers in the columns after each transaction.

1. Cash
2. Contributed Capital, Treasury stock transactions
3. Common Stock
4. Common Stock subscribed
5. Subscriptions Receivable, common stock
6. Retained Earnings
7. Retained Earnings restricted by the purchase of treasury stock
8. Treasury Stock
9. Premium on common stock
10. Legal expenses

Example: Paid cash for legal expenses

1. Purchased 500 shares of the outstanding $20 per value common stock at $23 per share and placed it in the treasury. p. 532
2. Recorded the restriction on retained earnings associated with transaction 1. p. 534.
3. Sold 300 of the treasury shares of transaction 1 at a price above that paid for the shares. p. 535.
4. Reduced the recorded restriction on retained earnings as a result of transaction 3. p. 534.
5. Accepted subscriptions to common stock at a premium. p. 530.
6. Collected in full the transaction 5 subscription to common stock, p. 531.
7. Issued common stock to the subscribers who paid their subscriptions in transaction 6, p. 532.

Debit	Credit
10	1

Part IV - 8 points

On May 25 when its stock was selling for $15 per share, the balance sheet of a corporation showed the following stockholders' equity:

Common stock $10 per value, 40,000 shares authorized, 30,000 shares issued	$300,000
Premium on common stock	30,000
Retained earnings	90,000
Total stockholder's equity	$420,000

The corporation's board of directors met on May 25 and declared a 5,000-share stock dividend distributable on June 8 to the June 2 stockholders of record. In the space below give without explanations the entries to record the declaration and distribution of the divident. Skip a line between entries.

The book value per share of the corporation's stock on May 25 was $______________________.
The book value per share after the dividend distrbution was $__________________________.
Kay Gilpin owned 300 shares of the corporation's stock on May 25, and the total book value of these shares was $______________. If she neither bought nor sold any of the company's shares between May 25 and June 8, after she received her dividend shares the book value of all her shares was $______________.

SAMPLE RETAKE

Student's number ______________

Grader's name ______________

Part I - Fill in the blank - 2 points

1. Extraordinary items are transactions and events that are both ______________ and occur infrequently in the operating environment of a business. p.547.
2. The appropriation of Retained Earnings ______________ (does, does not) set aside cash or funds for a special purpose. p. 543.

Part II (4 points) - p. 542

On the date interest was paid a corporation had $2,000,000 of convertible bonds outstanding on which there was $18,000 of unamortized discount. The bonds were convertible at the rate of 45 shares of the company's $20 par value common stock for each $1,000 bond and on that date bondholders presented $1,000,000 of the bonds for conversion. In the space that follows give without an explanation the entry to record the conversion.

Part III - (7 points)

Following are several account names with each account name preceded by an identifying number. Below the names are 7 transactions of a corporation. Indicate the accounts debited and credited in recording each transaction by placing the appropriate account identifying numbers in the column after each transaction.

1. Cash
2. Contributed Capital, Treasury stock transactions
3. Common stock
5. Common stock subscribed
6. Retained Earnings
7. Retained Earnings Restricted by the purchase of treasury stock

Part IV Example: Paid cash for legal expenses

Debit	Credit
5	1

1. Purchased 600 shares of the outstanding $25 par value common stock at $28 per share and placed it in the treasury. p. 532.
2. Recorded the restriction on retained earnings associated with transaction 1. p. 534.
3. Sold 500 of the treasury shares of transaction 1 at a price above that paid for the shares. p. 535.
4. Reduced the recorded restriction on retained earnings as a result of transaction 3. p. 534.
5. Accepted subscriptions to common stock at a premium. p. 530.
6. Collected in full the transaction 5 subscription to common stock. p. 531.
7. Issued common stock to the subscribers who paid their subscriptions in transaction 6. p. 532.

Part V (8 points)

On October 16 when its stock was selling at $30 per share, the balance sheet of a corporation showed the following stockholders' equity:

Common stock $20 par value, 60,000 shares authorized	
40,000 shares issued	$800,000
Premium on common stock	80,000
Retained earnings	470,000
Total stockholders' equity	$1,350,000

The corporation's board of directors met on October 16 and declared a 5,000-share stock dividend distributable on November 10 to the November 4 stockholders of record. In the space that follows give without explanations the entries to record the declarationand distribution of the dividend. Skip a line between entries.

The book value per share of the corporation's stock on October 16 was $________________. The book value per share after the dividend distribution was $______________. Karen Harrison owned 200 shares of the corporation's stock on October 16, and the total book value of these shares was $____________. If she neither bought nor sold any of the company's shares between October 16 and November 10, after she received her dividend shares the book value of all of her shares was $________________.

SAMPLE FORMATIVE QUIZ - BIOLOGY 101

Formative Test A

Unit II

Gallagher
Loop

Choose the correct letter to match the process below. Blacken in the correct letter on your Answer Sheet.

A. Active Transport
B. Osmosis
C. Diffusion
D. Hemolysis
E. Crenation

1. Erythrocyte (red blood cell) rupture in hypotonic solution (pure H_2O).
2. Passive cell membrane transport requiring no energy but requiring H_2O movement through a membrane from high to low concentration.
3. Active cell membrane transport requiring energy to move molecules against a concentration gradient.
4. Particle (molecule) movement from an area of greater concentration to one of lesser concentration.
5. Erythrocyte (red blood cell) shrinkage if placed in hypertonic solution (salt water).

Using the following key, match the cell organelles with the statement. Write the correct letter on the Answer Sheet.

6. Contains chlorophyll, found in plant cell cytoplasm, and functions in photosynthesis.
7. Spherical bodies attached to the endoplasmic reticulum responsible for the sythesis of protein.
8. Prominent structure, centrally located in the cytoplasm, responsible for cell reproduction.
9. Contain their own DNA and ribosomes, have an inner membrane (cristae), and function
10. Semi-permeable protein lipid layer that controls molecular entry to and exit from cell.
11. Located in cytoplasm also, store enzymes that cause cell destruction.
12. In cytoplasm, accumulate cellular secretions.
13. Common only to plant cells. Rigid support structure that protects the cell.

A. Lysosomes
B. Ribosomes
C. Mitochondria
D. Golgi complex
E. Chloroplast
AB. Nucleus
AC. Cell Wall
AD. Cell Membrane

Blacken the correct answer on your Answer Sheet.

14. The ability of the body to sweat when it becomes overheated is an example of the internal balance known as:
    a. ionization; b. muscle contraction; c. respiration; d. homeostasis
15. Cell division in plant and animal cells resulting in two genetically identical daughter cells is called:
    a. meiosis; b. metaphase; c. mitosis; d. fusion

SAMPLE RETAKE

Choose the correct letter to match the process below. Blacken in the correct letter on your Answer Sheet.

Use the Key: to answer the following questions 1-5.

A. Diffusion
B. Osmosis
C. Hypertonic
D. Active transport
E. Hypotonic

1. Hemolysis of a semi-permeable membrane filled with a sugar solution would occur because the solution is:
2. The diffusion of H_2O through a semi-permeable membrane from a region of greater concentration is of H_2O to a region of lesser concentration is an example of:
3. The movement of molecules during diffusion that requires an expenditure of energy.
4. The spreading out of molecules in a given space from a region of greater concentration to one of lesser concentration.
5. A solution containing a higher concentration of solutes and a lower concentration of water molecules.

Using the following Key: match the cell organelles for 6-13 with the statement. Write correct letter on the Answer Sheet.

6. The living part of the cell that continuously regulates what enters and leaves the cell.
7. Organelles in the cytoplasm that package cell secretions such as enzymes and hormones.
8. Robosomes function in the synthesis or this substance.
9. The power house of the cell.
10. Organelles containing enzymes that can decompose cells when released.
11. A cell plastid containing chlorphyll.
12. The cell's information control center and is usually found in the center of the cell.
13. Support structure that protects the cell and surrounds the cell membrane.

KEY: A. Nucleus
B. Chloroplast
C. Mitochondria
D. Cell Membrane
E. Protein
AB. Cell wall
AC. Golgi bodies
AD. Lysosomes

Blacken the correct answer on your Answer Sheet.

14. A steady state that an organism maintains by self-regulating adjustments:
    a. isotonic; b. turgor; c. respiration; d. homeostasis.
15. Chromosomal duplication occurs in interphase resulting in two identical strands in prophase:
    a. meiosis; b. chromatin; c. mitosis; d. metaphase.

SAMPLE FORMATIVE QUIZ
ENGLISH 197 or 103

Alan Meyers
Truman College

Quiz 3 Form A Writing with Confidence Past-Tense and Past-Participle Forms

1. Write the past-tense ending found on all **regular verbs**.

Questions 2-6. On your answer sheet, identify the tense of each of the following sentences by circling past or present.

2. They walk into the store.
3. I spend eight dollars a day.
4. He worked hard on it.
5. Tim wanted to answer the question.
6. You seem tired.

Questions 7-10. On your answer sheet, circle the appropriate form of have for each of the following sentences.

7. After the Schaffnits (have) played the record, they listened to another.
8. Beth (have) lived in the city since 1965, and she doesn't intend to move.
9. I (have) already cleaned the house, but Lonnie wanted to clean it again.
10. The lawn (have) been mowed two weeks earlier, but it needed it again last week.

Questions 11-34. On your answer sheet, write the correct past-tense or past-participle form -- whichever the sentence requires — of the verb in parentheses in each sentence.

11. You (be) wonderful yesterday.
12. (Be) John and Maria talking last hour?
13. Why (be + not) She at School?
14. I (be + not) in town.
15. He (lose) some time traveling to work.
16. Inez (have) a headache yesterday.
17. You (leave) your hat at the restaurant.
18. I was (suppose) to call you.
19. They had (catch) the flu before I did.
20. We should have (go) straight home.
21. The movie has (begin).
22. The man's arm was badly (hurt).
23. The toy may be (break).
24. Terry (throw) a pass.
25. Where have you (ride) in your new car?
26. Has he (eat) all the pie?
27. The secret is (hide) from everyone.
28. The ice cream was (freeze).
29. I (buy) a loaf of bread.
30. We (see) it.
31. A man (name) Smitty was looking for you.
32. The ship (sink).
33. We (bring) some candy.
34. Andy (teach) us a lesson.

SAMPLE RETAKE

Quiz 3 Form B Writing with Confidence Past-Tense and Past-Participle Forms

1. The verbs that end in -ed in the past tense and past participle are called _______ verbs.

Questions 2-6. On your answer sheet, identify the tense of each of the following sentences by circling past or present.

2. Who owned the bicycle?
3. We talk for hours.
4. They seem fine to me.
5. You sound tired.
6. The bear growled at each passing child.

Questions 7-10. On your answer sheet, circle the appropriate form of have in each of the following sentences.

7. Before he (have) graduated, he had taken forty-five hours of chemistry courses.
8. Soon after you (have) moved to your new house, please call me.
9. I (have) planted many flowers this year, and they look beautiful.
10. Ms. Moy, who works in the accounting department, (have) just been promoted.

Questions 11-34. On your answer sheet, write the correct past-tense or past-participle form — whichever the sentence requires — of the verb in parentheses in each sentence.

11. They (be+not) in a good mood.
12. (Be) Lawrence and you out bowling last night?
13. Their work (be) excellent.
14. What (be) you doing?
15. We (be + not) wrong.
16. He (sleep) for eight hours.
17. We (catch) several fish.
18. I (use) to do it.
19. We have (fight) about it several times.
20. I could have (do) better.
21. The school (hold) a big dance for homecoming.
22. He has (drink) more than he should.
23. The team was (beat) badly.
24. I (know) Fred Tracy years ago.
25. Has he (take) the test?
26. The letter was (write) by hand.
27. You (drive) a hard bargain.
28. I (buy) it on sale.
29. They (do) it.
30. Don't drink that (spoil) mile.
31. She (swim) two miles.
32. I (think) he looked familar.
33. The car (park) on the corner is a Buick.
34. The team (lose) by thirty points.

SAMPLE FORMATIVE QUIZ

Richard Williams
Malcolm X College

Mathematics 111 - Unit 1 - Integers (A)

1. The absolute value of 14 is _____
2a. The additive inverse of 7 is _____
 b. The additive inverse of -8 is_____
3. Add the following:
   a. -20 + (-25) b. -70 + 50 c. -17 + 30
4. Subtract the following:
   a. 10 - 35 b. -16 -50
5. Simplify: -6 + 9 - 15
6. Multiply the following:
   a. (-10) (-4) b. 8(-5)
   c. (-2) (4) (-5) d. (-2) (-3) (5) (-2)

7. Divide the following:
a. $\frac{-60}{-10}$ b. $\frac{-60}{6}$

8. Simplify the following:
a. -7 - 3(5) b. 7 + 7 (7-7) c. 2 5 + 2(5-9)
9. How do you add integers with different signs?

SAMPLE RETAKE

1. The absolute value of 7 is_____
2a. The additive inverse of 13 is _____
b. The additive inverse of -10 is_____
3. Add the following:
a. 30 + (-15) b. -50 - 15 c. -15 + 25
4. Subtract the following:
a. 30 - 47 b. -15 - (-40)
5. Simplify: -4 -16 +17
6. Multiply the following:
a. (-9) (-7) b. 7 (-4)
c. (-2) (-3) (10) d. (-3) (-4) (-5) (2)
7. Divide the following:
a. $\frac{-600}{-10}$ b. $\frac{-35}{7}$
8. Simplify the following:
6 -2(10) b. 6 + 6(-8-1) c. 3 -2 + 4(6-8)
9. How do you multiply integers?

SAMPLE FORMATIVE QUIZ

Collette Walker
Wright College

READING 126
TEMPORAL RELATIONSHIPS
FORM A

DO NOT WRITE ON THIS TEST. PUT ALL ANSWERS ON ANSWER SHEET.

1. Temporal means
   A. having to do with time.
   B. temporary.
   C. permanent.
   D. the order of events.

2. Sequence means
   A. having to do with time.
   B. temporary.
   C. informative,
   D. the order of events in time.

3. Choose the group of words that indicates temporal relationships.
   A. type of, kind of, is
   B. that is, or, in other words
   C. before, also, next
   D. however, on the other hand, yet

For questions 4 and 5, map each sentence below.

4. Before a child can walk, it must learn to crawl.

5. She dug a hole in the earth and dropped a peach pit into it. Next she covered the hole and smiled.

For question 6, write a sentence that explains this map.

6. progress toward equality of blacks and whites was painfully slow → Civil Rights movement of 1960's.

Read the paragraph below, then answer the questions.

Health physics is the science of measuring the amount of radiation injurious to the continued health of a person. After the rise of atomic energy, health physics became a necessity for workers in atomic energy plants. Later it became necessary to measure amounts of radiation in the earth's atmosphere which might injure the general population. Today health physics is a science involved in constant measurement and regulation advice for atomic use.

7. Write two key words based on the paragraph to indicate temporal relationships.
8. How many events are given in this paragraph?
9. Map the paragraph (4 points).

SAMPLE RETAKE

DO NOT WRITE ON THIS TEST. PUT ALL ANSWERS ON ANSWER SHEET.

1. Sequence means

   A. having to do with time.
   B. the order of events in time.
   C. temporary.
   D. temporal indicators.

2. Temporal relationships

   A. are temporary.
   B. can be changed in order.
   C. state the order of events.
   D. do not give the order of events in the real world.

3. Choose the group of words that indicates temporal relationships.

   A. after, finally, when
   B. defined as, is are
   C. two, many, things (plural words)
   D. therefore, thus, in summary

For questions 4 and 5, map each sentence below.

4. Before people invented the written alphabet, they had to transmit their history and important cultural events orally.

5. After listening to both the prosecution and the defense, the judge dismissed the case for lack of evidence.

For question 6, write a sentence that explains this map.

6. World bank receives funds from developed countries → World Bank makes loans to developing countries.

Read the paragraph below, then answer the questions.

Studying for an exam requires good lecture notes. Obviously the most important thing in taking good lecture notes is bringing to class adequate paper and a pen that won't run out of ink. As you listen to the instructor speak, decide what the main point of the lecture is. Write that main point in your notes. You should continue to listen even as you write. Sub-points that explain the main idea can be indented as in an outline. Finally, before you study, read your notes over for mistakes or omissions.

7. Write two key words used in this paragraph to indicate temporal relationships.
8. How many events are given in this paragraph?
9. Map the paragraph (4 points).

Exercise 7.1

Write one alternate retake test item for each item on the corresponding formative quiz. Make sure that each alternate item tests the same objectives as the formative quiz item, and that it is on the same taxonomic level. This will fulfill Objective 7.1.

SETTING STANDARDS OF PERFORMANCE ON RETAKE TESTS

Standards of performance should be set for each specific outcome or for each instructional objective. According to Gronlund (1973), 100 per cent mastery might seem to be the ideal criterion for a mastery test. However, the work of Block (1971) suggests that 80 to 85 percent correct is a more realistic standard. He noted that setting the standard too high may be wasteful of teacher and student time, and may have a negative effect on student motivation. A realistic standard tends to provide more opportunities for student success and thus increases the amount of positive reinforcement. Block and Anderson (1975) suggest:

> As a rule of thumb...that you set your standard stringent enough so that if most students attain it, you can say with confidence that your students' learning has improved rather than that your standards have slipped.
>
> In setting your standard ...think of mastery in terms of how well you would expect an "A" student to perform with respect to the items which test for each course objective.

Reviewing the steps for setting standards of performance for formatives on pp. 5-9 and 10 in Unit V will also help you develop criteria for performance on retakes.

Norman E. Gronlund Preparing Criterion-Referenced tests for classroom Instruction. New York: The Macmillan Company, 1973.

James H. Block and Lorin W. Anderson. Mastery Learning in Classroom Instruction. New York: Macmillan Publishing Co., Inc., 1975.

Exercise 7.2

Set the criterion level for mastery on each of your retake tests. This will help you meet Objective 7.2.

Exercise 7.3

Many times, mastery teachers face situations which force them to modify the formative/corrective/retake cycle. Following are four typical problems; you should describe a modification you would make to the corrective phase of your course to remediate this problem. Also, explain your reasons for making the modification. This exercise will help you meet Objective 7.3.

1. Several students are continually absent from class.
2. Several students in your class have a language problem and cannot keep up with your group-instruction method.
3. A student in your class has taken a formative and a retake exam for Unit 1 and did not reach mastery on either test.
4. Several students in your class have external responsibilities (e.g., job, family) and cannot spend the time needed to complete course requirements at home.

PLANNING THE FORMATIVE/CORRECTIVE/RETAKE CYCLE

The formative/corrective/retake cycle should include procedures for determining specific learning difficulties, the reasons for learning difficulties, and the corrective process appropriate to the nature of the learning difficulty. The following steps will help you to plan your formative/corrective/retake cycle.

STEPS IN PLANNING FORMATIVE/CORRECTIVE/RETAKE CYCLES

1. Correct unit formative tests.
2. Record results of the formative test.
3. Identify students performing below mastery.
4. Determine test items missed by a significant number of students.
5. Determine what materials need to be retaught to the whole class or to all students not achieving mastery.
6. Determine how to monitor the individual corrective process:
   -will you collect the correctives,
   -ask students whether they have done the correctives, or
   -check on their attendance at the tutors, the PLATO center, or the small group session?
7. Set deadlines for completion of correctives and formative retakes.
8. Define your retake process:
   -students take only the retake items for original items not mastered, or
   -all students needing correctives take a second form of the formative test.
9. Record results of the retake.
10. Determine what to do with students who do not master the retake:
    -check to see if they are using correctives,
    -assign another corrective, or
    -proceed with group instruction.

Exercise 7.4

Write a plan for implementing formative/corrective/retake cycles in your course. This will fulfill Objective 7.4.

Formative Quiz - Unit VII

1. Which of the following criteria is (are) important in building retake and parallel test items?
   I. each retake should reflect the same level of the taxonomy as the original test item
   II. each retake item should reflect the same objective as the original test item
   III. each retake item should require the same prerequisite skills to be mastered as the original test
   IV. each retake item should be of the same item type as the original test item (i.e., multiple choice, matching, etc.)

_____ A. I above

_____ B. I and II above

_____ C. I, II, and III above

_____ D. all of the above

Certain item types are more appropriate for checking mastery of learning tasks at various levels of the Taxonomy of Educational Objectives. Below are two columns, one representing item types, the other listing the major categories of the Taxonomy. Place the roman numeral for the level(s) of the Taxonomy for which particular item types are most appropriate.

2. _______ short answer
3. _______ true - false
4. _______ multiple choice
5. _______ essay

I. Knowledge
II. Comprehension
III. Application
IV. Analysis
V. Synthesis
VI. Evaluation

6. Sources other than objective test items may serve as formative evaluation instruments (i.e., paper, lab reports, homework assignments). However to be useful as a formative evaluation took, these sources must meet the criteria of what makes a good formative test. Which of the following criteria does not apply to building a good formative evaluation?

_____ a. each objective of the particular unit of instruction are assessed for mastery

_____ b. it is possible to judge which unit and/or lesson objectives have and have not been mastered

_____ c. it is possible to give the students an objective grade for performance

_____ d. corrective processes can be identified for helping students to correct learning tasks they are judged not to have mastered

7. In feedback/corrective cycles students should first work on correctives for the test items they found most difficult or those that they did not master.

_____ true
_____ false

Feedback/corrective cycles are designed to provide feedback for two different purposes. Describe these two purposes of feedback.

8. ____

9. ____

Good feedback/corrective cycles provide three different types of information for students in relation to their learning difficulties. Describe these three types of information.

10. ____

11. ____

12. ____

13. What is the purpose of determining what test items have been missed by a significant number of students?

____

There appear to be three different possible ways to proceed if a student does not master the retake evaluation. Describe these three alternatives.

14. ____

15. ____

16. ____

17. One purpose of formative evaluation is to anticipate potential results of summative evaluations.
_____ true
_____ false

ANSWERS

Formative Quiz - Unit VII

1. c
2. I, II
3. I
4. I, II, III, IV, V, VI
5. III, IV, V, VI
6. c
7. false
8. improving performance
9. improving curriculum, test item, improving learning experience
10. location of learning difficulties
11. reason for learning difficulties
12. appropriate correctives
13. provides feedback on effectiveness of teaching and curriculum and/or helps to determine what materials need to be retaught to the whole class
14. check to see if they are using correctives
15. assign another corrective
16. proceed onward with
17. true

UNIT VIII

DEVELOPING SUMMATIVE EVALUATIONS

OVERVIEW FOR UNIT VIII

The final step in developing a Mastery Learning course is the development of summative evaluations. Summative evaluations differ from the formatives in that they measure the end result. Formatives are used to determine what the student has mastered and what he still needs to review. Summatives are used primarily to assign grades; they may also be used for other purposes, such as certifying skills. The differences between formatives and summatives, and the uses which can be made of summatives, will be discussed in this unit.

This unit will also review the difference between absolute standards and grading on the curve. Absolute standards are based on pre-set criteria; anyone who meets these criteria gets the given grade. In grading on the curve, a fixed percentage of students can get each grade, no matter how well or poorly they perform. In mastery classes, where absolute standards are used, the grades, as well as the test items and the classroom instruction, are based directly on the course objectives.

These absolute standards are set by the instructor at the beginning of the course. They may be derived in a variety of ways, but generally each of the letter grades is tied to a pre-set number of objectives or a pre-set standard of performance. The methods of setting standards for summative evaluations and grades are discussed in greater detail later in this unit.

In this unit you will develop midterm and final summative evaluations and set criteria for mastery and grades. This unit includes some guidelines for writing these examinations, and for evaluating them once they have been written.

OBJECTIVES - UNIT VIII

8.1 Summarize the distinctions between formative and summative evaluations.

8.2 State the ways in which you will use your summative evaluations.

8.3 Construct mid-term and final summative evaluations.

8.4 Distinguish between norm-referenced standards, criterion-referenced standards, and grading on the curve.

8.5 Establish the standards for mastery and grades for your summative evaluations.

8.6 Describe the procedure you will use to evaluate and revise your summative evaluations.

FORMATIVE AND SUMMATIVE EVALUATION

The distinguishing characteristics between formative and summative evaluation have to do with purpose (expected uses), portion of course covered (time), and level of generalization sought by the items in the examination used to collect data for the evaluation. Since these characteristics are not absolute, it seems useful to give some examples of the differences.

The main purpose of formative evaluations is to determine the degree of mastery of a given learning task and to pinpoint the part of the task not mastered. The purpose is not to grade or certify the learner; it is to help both the learner and the teacher focus upon the particular learning necessary for movement toward mastery. On the other hand, summative evaluation is directed toward a much more general assessment of the degree to which the larger outcomes have been attained over the entire course or some substantial part of it. In fifth-grade arithmetic, for example, summative evaluation would have as its major purpose to determine the degree to which a student can translate word problems into quantitative solutions or his accuracy and rapidity in handling division. In formative evaluation the concern is with seeing whether a deficiency in translating word problems is due to vocabulary inadequacies or to inability to demonstrate arithmetic formulations, and the division question would focus on type of error. Here the purpose would be to direct both the student and the teacher to specific learnings needed for mastery.

It is quite true that a teacher might wish to try deriving both kinds of evaluation from one examination. However, the attempt would very likely demand a test which was much longer and more complex than advisable.

The characteristics of timing (position along the time line of the instructionlearning process) also enters into the differentiation of summative from formative evaluation of student learning. Tests for formative purposes tend to be given at much more frequent intervals than are the summative variety. It follows from the purposes described in the foregoing paragraphs that formative tests should be utilized whenever the preliminary instruction on a new skill or concept is completed. At least several skills or concepts which combine to make a broader ability should have been presented before a summative examination is administered. This sort of test is not intended solely for the end of a course, although certainly the final examinations given in most colleges and some secondary schools are summative - usually intended only for grading and certification. More frequently, tests of a summative nature are used two or three times within a course. Relatively short tests which come at the end of a short unit of instruction tend to have the other characteristics of formative evaluation also.

Perhaps level of generalization is the factor which differentiates summative from formative evaluation most sharply. The difference is one of generalizability or transferability. For example, in algebra one might have as an objective "the ability to construct and interpret graphs dealing with linear data." This implies the possession of a number of skills and knowledges - for example, the ability to locate points in a coordinate system and the ability to use signed numbers correctly. In formative evaluation an attempt would be made to observe the underlying prerequisite behaviors: summative evaluation would focus much more on the broad ability represented by the phrase "construct and interpret."

ADAPTED FROM: Bloom, B.S. et al. Handbook on Formative and Summative Evaluation of Student Learning. New York: McGraw-Hill Book Co., 1971.

Exercise 8.1

Summarize the distinctions between formative and summative evaluations. This will meet Objective 8.1.

USES OF SUMMATIVE TESTS

The summative examination may serve a variety of functions. There are steps in the construction and scoring of tests which help optimize each of these uses. It is quite true that the results of a given test may be employed in several different ways rather than only one. In either case, if the intended aim or aims are established clearly before the test is constructed, the results can be utilized more satisfactorily.

Test outcomes are not equally applicable to all uses at all levels of schooling or in all subject areas. Among the most commonly mentioned uses of test results are the following:

Assigning of grades
Certification of skills and abilities
Prediction of success in subsequent courses
Initiation point of instruction in a subsequent course
Feedback to students
Comparison of outcomes of different groups

In assignments of grades a single score - even though it is the sum of several others - is most useful. In certification a score may be obtained on each special skill or on particular abilities across specific subject areas. For prediction purposes a single score is most useful for empirical tests, although multiple forecasts allow the teacher to assess student performance and various behaviors.

For the initiation of instruction in subsequent courses, the scoring system should afford a range of scores applicable to the things which can be done in the next course. For feedback to students the scheme should tell them the things on which they can realistically operate - which skill or ability with which content; therefore, separate scores should be given for different behaviors. When you are comparing the outcomes of different groups or treatments, it would be well to use a scoring system which reflects differences in abilities, skills, and knowledges across subject areas or themes.

In summary, the intent of this section has been to describe the uses of summative examinations. It is possible for one examination to serve two or three different uses, though in general not efficiently.

It must be remembered that the rules concerning objectives apply to every instrument, whatever purpose it serves. Those rules stipulate that objectives should be stated in terms of observable performance. Summative examinations do not differ from formative or diagnostic examinations in the requirement that they be based on clearly stated objectives.

ADAPTED FROM: Bloom, B.S. et al. Handbook on Formative and Summative Evaluation of Student Learning. New York. McGraw-Hill. 1971.

Exercise 8.2

Describe the ways you will use your summative evaluation. This will fulfill Objective 8.2.

WHAT MAKES A GOOD TEST?

A well-constructed test measures how effectively the instructor has presented the course material and how much the student has learned. Follow these guidelines when constructing and administering every test:

1. Provide clear, unambiguous directions.
2. Ask questions simply and directly.
3. Avoid trick questions.
4. Structure the test so that it corresponds with the objectives for the course.
5. Accumulate test questions before or as you cover the course content. Avoid compiling them immediately before constructing the test. Write test items on index cards, and develop a file or test bank from which to select.

6. Be available to answer students' questions during the test.
7. Design the test so that it can be reliable, easily, and accurately scored.

ADAPTED FROM: The League for Innovation in the Community College. Teaching in the Community College: An Orientation. New York. HBJ Media Systems Corporation. 1981.

CONSTRUCTING SUMMATIVE EVALUATIONS

Unless the summative evaluation is exceptionally long, it will not be able to cover every single one of the class objectives. They should be covered on the formatives. For example, an objective may be: "Add positive and negative integers," and the test item on the formative may be: "Add: +9 + (-12)." The overall goal would be: "Solve:

$$3x^2 + 5x + 6 = 0$$

by using the quadratic formula." In this case, the teacher assumes that if a student can solve quadratic equations, he knows how to add positive and negative integers. This principle of testing more generally on the summative evaluation applies to every class in which certain objectives must be mastered in order to achieve the basic course goals.

After drawing up a list of potential summative test items, the teacher should compare them to his table of specifications or his list of goals and objectives for the course. In this way, the instructor can determine whether or not there is consistency among the objectives, the course instruction, and the summative evaluation. Bloom suggests:

1. Develop a table of specifications for the subject area and taxo nomic level. (Check Unit III for directions if you have not already done so.)

2. Develop test items which fit the applicable cells in the matrix.

3. Select items that test your major objectives.

4. Assemble the items according to some plan. (Bloom suggests that the teacher group items by content, behavior, or type — multiple choice, etc.).

5. Develop a scoring scheme which will furnish the most useful information for the examination purpose or purposes.

ADAPTED FROM: Bloom, B.S. et al. Handbook on Formative and Summative Evaluation of Student Learning. New York: McGraw-Hill. 1971.

SAMPLE TEST ITEMS ILLUSTRATING THE LEVELS OF THE TAXONOMY

One of the characteristics of a good summative test item is that it tests the student's mastery of an objective at the same level of the Taxonomy at which the objective was taught. For example, if the objective was to memorize the definitions of the parts of speech, the associated test item should test for the recall of those definitions. The appropriate level of the taxonomy for such an item would be the Knowledge level. If the objective was to identify words as certain parts of speech — for example, as nouns, verbs, or adverbs — the associated test item should test for the ability to make those identifications. This would require test items at the Applications level of the Taxonomy.

The Tables of Specifications make clear the appropriate taxonomic level for test items covering each content item in the course. The following examples will illustrate typical test items at each level of the Taxonomy. Some care is needed in interpreting the level of these items because the instruction to be given on the content determines in part what mental processes the student must use to answer the question. For example, if the item requires the student to match terms with their definitions and the definitions given exactly match those given in the instruction, the test item involves only recall and so is at the Knowledge level. If the definitions given in the test item are not identical to those given in the instruction, the student will need to translate as well as recall in order to answer the question. In this situation the item would be at the Comprehension level. We have chosen items that are typical of each level.

We give examples of all levels of the Taxonomy. The individual teacher must decide which levels of the Taxonomy at which to write test items. Few tests contain representatives from all levels, and a preponderance of items at lower levels is not uncommon.

Examining the following items will help you recognize differences among items written at the various levels of the Taxonomy. This will help you meet objective 8.4.

Knowledge

Knowlege objectives emphasize the psychological processes of remembering. For measurement purposes, the recall situation involves little more than bringing to mind the appropriate material. Although some alteration of the material may be required, this is a relatively minor part of the task.

The following items were excerpted from a biology exam written by Anita Lendway of Chicago City-Wide College, one of the City Colleges of Chicago. The first tests for knowledge of facts, the second for knowledge of terms.

1. If a nerve is cut, regeneration of the nerve can occur if the injury involves the:

   a. White matter of the brain
   b. The spinal cord
   c. Cell bodies of special sensory neurons
   d. Processes of peripheral neurons

2. In which lobe of the brain is the visual cortex located?

   a. Occipital
   b. Temporal
   c. Frontal
   d. Parietal

Comprehension

This represents the lowest level of understanding; the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

The following item was excerpted from a college algebra test written by Richard Williams of Malcolm X College, one of the City Colleges of Chicago. It tests for the ability to translate word problems into algebraic notation; translation is one of the skills involved in comprehension.

8. Math 111 has 13 more students enrolled than Math 103. If the total number of students in both cases is 59, how many students are enrolled in Math 111 and how many are in Math 103?

Application

These skills involve the use of abstractions in particular, concrete, and novel situations. The abstractions may be in the form of general ideas, rules of procedures, or generalized methods.

The following item is excerpted from an accounting exam used by Don Radtke of Daley College, one of the City Colleges of Chicago.

On June 22, when its stock was selling at $16 per share, the balance sheet of a corporation showed the followng stockholders' equity:

Common stock $5 per value, 50,000 shares authorized, 20,000 shares issued..........................	$100,000
Premium on common stock................	20,000
Retained earnings..............................	
Total stockholders' equity.................	$120,000

The corporation's board of directors met on June 22 and declared a 1,000-share stock dividend distributable on July 11, to the July 5, stockholders of record. In the space that follows give without explanations the entries to record the declaration and distribution of the dividend. Skip a line between entries.

Analysis

Analysis objectives emphasize the breakdown of a communication into its constituent elements of parts such that the relative hierarchy of ideas is made clear and the relations between the ideas are made explicit.

The following example is excerpted from a reading exam written by Collette Walker of Wright College, one of the City Colleges of Chicago.

For each sentence below, identify the concept, the key words, and the relationship. To identify the relationship on the answer sheet, circle D for definition, E for example, or P for property.

Two major types of the potter's craft are handbuilt and wheel-thrown pottery.

21. The concept is _____.
22. The key words are _____.
23. The relationship expressed in the sentence is _____.

Synthesis

Synthesis objectives emphasize putting together parts and elements so as to form a whole and arranging and combining them in such a way as to constitute a pattern or structure not clearly there before.

The following example was excerpted from the Taxonomy of Educational Objectives, Handbook 1: Cognitive Domain, and would be suitable for a composition course.

> DIRECTIONS: Think of a plot based upon an obstacle that could occur between the following two sentences, and then develop a short story using these sentences and your plot.
>
> It was an event to be honored with a party, preferably a surprise party... "It was a surprise, all right — a surprise all the way around!"

Evaluation

Evaluation objectives emphasize judgments about the value of material and methods for given purposes, quantitative and qualitative judgments about the extent to which material and methods satisfy criteria, or the use of a standard of appraisal. The criteria may be determined by student or may be given to him.

The following item was adapted from the Taxonomy of Educational Objectives and would be suitable for a course in American literature.

> DIRECTIONS: Write a 250 to 500 word essay describing and evaluating Robert Frost's poem "Stopping by Woods on A Snowy Evening." In your description you should employ such terms as will reveal your recognition of formal characteristics of the poem. Your principles of evaluation should be made clear although they should not be elaborately described or defended.

Exercise 8.3

Construct midterm and final summative examinations. Make sure that each of your test items is directly related to one of your course goals. This will help fulfill Objective 8.3.

SETTING STANDARDS

There are various ways to set standards for summative evaluations. These standards can be norm-referenced or criterion-referenced, but they should be absolute.

Norm-referenced standards are based on the scores of other students. A well-known example is the Scholastic Aptitude Test (SAT). An instructor may base the standards for his mastery class on how well students have performed in similar classes in the past. For example, a typing teacher may decide that students need to type 35 w.p.m. on their test in order to get an A because, in the past, students who have been able to type 35 w.p.m. have been given an A. This is a valid use of norm-referenced standards. Similarly, a teacher who is teaching a class for the first time may talk with more experienced teachers in his department to find out what performance standards correspond to each of the grade levels.

Referring back to previous standards will help the instructor set standards which are realistic and consistent with the rest of the department. The point is that, once these norm-referenced standards have been set, they should become absolute. Absolute standards mean that the student will have to meet pre-set criteria in order to earn a specific letter grade. In other words, every typing student who types 35 w.p.m. will get an A, and only those students who do reach 35 w.p.m. will get A's.

Standards may also be criterion-referenced. That is, they may be designed to measure the objectives taught. These objectives and standards may be based on the teacher's own experience of what needs to be taught in the class. If the class is a prerequisite for another one, the standards may be based on what is needed for the next class. Or if the class is required for a license or certification, standards should be based on what is necessary in order to qualify for that license or certification. Employment requirements and student needs must also be considered. Criterion-referenced standards should also be absolute.

In contrast to absolute standards is the practice of grading on the curve. In that system, a student's letter grade is determined by his performance in relation to other students in the class. In other words, a B student has performed better than a C student and not as well as an A student in that class. This may seem fair at first,but it means, in effect, that only a certain percentage of students will receive A's, no matter how many of them have actually mastered the course objectives.

Grading on the curve may seem to be similar to norm-referencing but there are several distinct differences. With norm-referencing, the standards are derived from large groups of students prior to the testing and grading; with grading on the curve, standards are derived for this class only. In a norm-referenced class, every student who achieves at a given level gets the grade for that level; in a class that is graded on the curve, only a fixed number or percentage of students receive each grade. If a teacher uses norm-referenced standards, those standards remain the same from class to class; if he uses the curve, these standards vary from class to class.

There are several advantages to using absolute standards. They reduce the cause for competition and promotes cooperation instead. They follow the current emphasis on competencies. They also promote more responsible student attitudes; they make the student in charge of his own grade. Mainly, they focus the grades, like all the other aspects of the course, on the course objectives.

Remember:

* These terms norm-referenced, criterion-referenced, and graded on the curve, refer to the way that test results are interpreted, not to the test questions themselves.

* Norm-referenced standards are based on the scores of large numbers of students who have taken the same course or exam.

* Criterion-referenced standards are derived from the objectives themselves.

* Students who are graded on the curve are measured against their current classmates. Only a certain number or a certain percentage in each class will receive a given grade.

* Absolute standards, whether norm-or criterion-referenced, are based on preset criteria. Absolute standards are recommended for mastery classes.

Exercise 8.4

Give a one-sentence definition of each of the following terms: norm-referenced standards, criterion-referenced standards, and grading on the curve. This will fulfill Objective 8.4.

NORM-REFERENCED VS. CRITERION-REFERENCED TESTS

It is not possible to tell a norm-referenced test from a criterion-referenced test by looking at it. In fact a criterion-referenced test could also be used as a norm-referenced test -- although the reverse is not so easy to imagine. However, this truth should not be allowed to obscure the extremely important differences between these two approaches to testing.

At the most elementary level, norm-referenced measures are those which are used to ascertain an individual's performance in relationship to the performance of other individuals on the same measuring device. The meaningfulness of the individual score emerges from the comparison. It is because the individual is compared with some normative group that such measures are described as norm-referenced. Most standardized tests of achievement or intellectual ability can be classified as norm-referenced measures.

Criterion-referenced measures are those which are used to ascertain an individual's status with respect to some criterion, i. e., performance standard. It is because the individual is compared with some established criterion, rather than other individuals, that these measures are described as criterion-referenced. The meaningfulness of an individual score is not dependent on comparison to others. For example, the dog owner who wants to keep his dog in the back yard may give his dog a fence-jumping test. The owner wants to find out how high the dog can jump so that the owner can build a fence high enough to keep the dog in the yard. How the dog compares with other dogs is irrelevant.

Since norm-referenced measures are devised to facilitate comparisons among individuals, it is not suprising that their primary purpose is to make decisions about individuals. Which pupil should be counseled to pursue higher education? Which pupils should be advised to attain vocational skills? These are the kinds of questions one seeks to answer through the use of norm-referenced measures, for many decisions regarding an individual can best be made by knowing more about the "competition," that is, by knowing how other, comparable individuals perform.

Criterion-referenced tests are devised to make decisions both about individuals and treatments, e. g., instructional programs. In the case of decisions regarding individuals, one might use a criterion-referenced test to determine whether a learner had mastered a criterion skill considered prerequisite to his commencing a new training program. In the case of decisions regarding treatments, one might design a criterion-referenced measure which reflected a set instructional objectives supposedly achieved by a replicable instructional sequence. By administering the criterion-referenced measure to appropriate learners after they had completed the instructional sequence, one could reach a decision regarding the efficacy of the sequence (treatment).

Although both norm-referenced and criterion-referenced tests are used to make decisions about individuals, there is usually a difference in the two contexts in which such decisions are made. Generally, a norm-referenced measure is employed where a degree of selectivity is required by the situation. For example, when there are only limited openings in a company's executive training program, the company is anxious to identify the best potential trainees. It is critical in such situations, therefore, that the measure permit relative comparisons among individuals. On the other hand, institutions where one is only interested in whether an individual possesses a particular competence, and there are no constraints regarding how many individuals can possess that skill, criterion-referenced measures are suitable. Theoretically, at the close of many instructional programs we might hope that all learners would display maximum proficiency on measures reflecting the instructional objectives. In this sense, of course, criterion-referenced measures may be considered absolute indicators. Thus, both norm-referenced and criterion-referenced tests can be focused on decisions regarding individuals -- it is the context within which these decisions are made that really produces the distinction.

*EXCERPTED FROM: Popham, J.W., and Husek, T.R. "Implications of Criterion-Referenced Measurement," in Criterion-Referenced Measurement. Edited by J. W. Popham. Englewood Cliffs, New Jersey: Educational Technology Publications, 1971.

Exercise 8.5

Establish the standards for mastery and grades for your summative evaluations. This will meet Objective 8.5.

CORRESPONDENCE TABLE

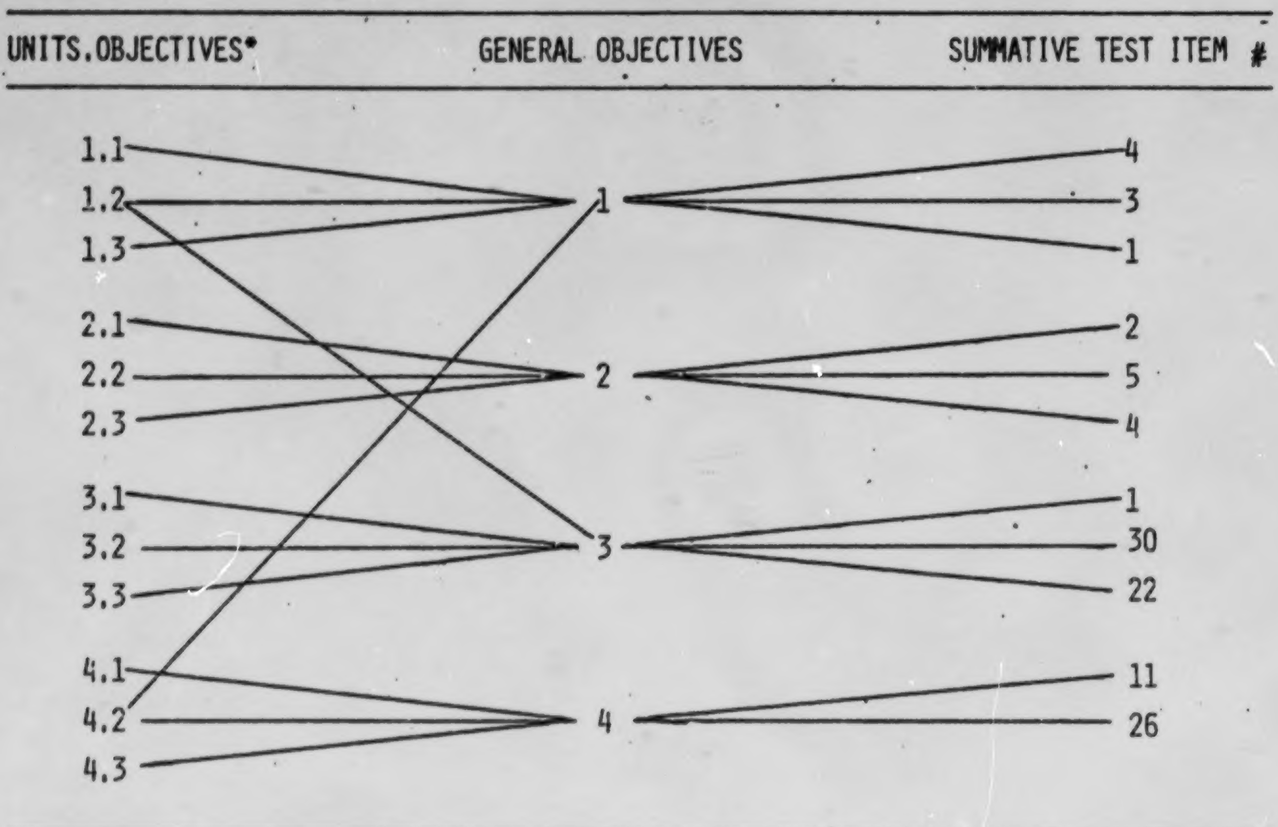
The correspondence table is a graphic device to insure that all of your course objectives are covered on the summative examination. The table serves as a guide to review your work and to integrate it in preparation for building summative examinations. The following example of a correspondence table will help you to construct your own table.

The correspondence table is divided into three sections:
1) unit objectives,
2) general course objectives, and
3) summative test items.

In the first section of the table, each of your units and each of your objectives are listed in sequential order. For example, 1.1, 1.2, and 1.3 on the sample table represents the first, second and third objectives in Unit I. You should identify subsequent units and course objectives just as they are shown on the sample correspondence table. In the second section of the table, list your general course objectives. Refer to Unit IV for the general course objectives you have already developed. The third section of the table indicates the summative test item(s) that cover each of your course objectives.

Now that you have listed your unit objectives, general course objectives, and the items of your summative evaluation, draw lines to show the relationship between unit objectives, general course objectives, and summative test items. It is also possible for your unit objectives to relate to one or more of your general objectives or summative test items.

CORRESPONDENCE TABLE



*AS STATED IN PREVIOUS UNITS, SPECIFIC OBJECTIVES MUST REFLECT BLOOM'S TAXONOMY.

REVISING THE SUMMATIVE EVALUATION

After giving a summative examination, the teacher should evaluate it before using it again. Also, if the test is going to be used as a department or school-wide examination, the teachers involved probably should give the examination to a sample group of students before adopting it.

Below are some suggestions for evaluating and revising an examination. The technical terms (validity, reliability, objectivity, item difficulty, and item discrimination) are discussed in the selection which follows.

1. Give the test and the table of specifications to a competent judge (another specialist in your own area) for a content validity assessment. You may want to give the test to more than one judge to ensure that the items actually do test the course objectives.

2. Obtain a measure of difficulty for each item. If the test item is valid and difficult, a mastery teacher may want to revise the item or revise the teaching of that objective.

3. Determine the discriminating power of each item. If the index for better students is larger than for poorer students — that is, if more of the better ones pass the item - the item discriminates positively and hence properly.

4. Determine the reliability of test results. Revise the examination accordingly.

CHARACTERISTICS OF TESTS

Content Validity

Content validity refers to the correspondence between achievement test items and the objectives which the test is meant to measure. For example, an item in an algebra test which tests spelling would not be valid. The insistence that both instruction and examinations to evaluate learning should be tied to the same table of specifications (or objectives) is really an insistence on content validity.

As a way of testing validity, an instructor may ask his colleagues in the same field to check whether the test items actually measure mastery of the instructor's list of objectives.

Reliability

The reliability of a set of test scores refers to the consistency with which the results place students in the same relative position to other students if a test is given repeatedly. If the same test were administered to a given group twice, once in the morning and again in the afternoon, we would ordinarily expect the ordering of the examinees to be much the same for the two different times. If this were not so, we would say that the test results were not consistent. Similarly, if two samples of items representing the same content-behavior cells were given one after the other and the results were not approximately the same in terms of the relative ranking of the examinees, we would say that the results were not reliable. Clarifying any ambiguities in terms and directions will generally improve both reliability and validity.

Scoring Objectivity

Objective scoring of examinations — unbiased, free from personal opinions — is not a topic which pertains solely to summative evaluations. However, there are reasons for special concern with objectivity in the scoring of the final test for a given course. When one is doing diagnostic examining or the kind of formative evaluations which take place during the course, there are always opportunities for correcting the conclusions derived from the data by later testing. With a final examination — at the end of a course or a larger unit — the general expectation is that we will have no further data for correcting the inferences we have drawn.

Objectivity in scoring has to do not only with fairness but with validity and reliability. No matter how well the test matches the table of specifications or the intended outcome, if any element in the scoring brings about inaccuracies in its application, then content validity is lowered. If any bias in the scoring causes the same relevant behavior to be scored differently for different examinees, then both the validity and the reliability of the results are lowered.

Item Difficulty

Item difficulty measures how hard the test item is for the group tested. To obtain it, divide the number of students passing the item by the total number of students trying it. If the test is being used to distinguish between students (rather than to assess mastery), the teacher will want to reject questions which nearly everyone either passes or fails. In a mastery class, on the other hand, the teacher will be checking especially for those test items which the students found most difficult. If those items are valid, the teacher may then decide to revise either the test item itself or the teaching of that objective.

Item Discrimination

Item discrimination is an index comparing the percentage of top students with the percentage of poorer students who pass the same item. The words "top" and "poorer" or "more capable" and "less capable" usually have their reference to a total score on the test. Given a separation of the students into two such sets, the measure works as follows: If 50 percent of each group passes the item, it is said that the item does not discriminate. The same is true with any other close pair of percentages. If, on the other hand, 50 percent of the better group passes the item while only 30 percent of the poorer group does, the item is said to discriminate positively. Finally, if on another item 60 percent of the top students but 80 percent of the poorer students pass, the item is working in the opposite direction from the total test.

In a mastery class, item discrimination sends up a "red flag." It should not occur; in a mastery class, every student should have mastered the objective and, therefore, be capable of answering the test item. If the item discriminates between "top" and "poorer" students, the mastery teacher should ask himself a few questions. Is there something wrong with the test item itself? Is the language so difficult, for example, that only the more literate students can understand it? Or was the problem due to outside forces?

Whereas in a traditional class the teacher aims for positive discrimination, the teacher in the mastery class aims for no discrimination at all, since, if the instruction was correct, nearly all the students should master the objective. When a large number of items discriminate, the mastery teacher should consider revising his instruction.

ADAPTED FROM: Bloom, B.S. et al. Handbook on Formative and Summative Evaluation of Student Learning. New York. McGraw-Hill. 1971.

Exercise 8.6

Describe in your own words the steps you will take to evaluate and, if necessary, revise your summative evaluations. This will fulfill Objective 8.6.

Formative Quiz - Unit VIII

Items 1-5 describe a type of evaluation used in Mastery Learning. Place either an "F" for formative evaluation, and "S" for summative evaluation, or a "B" for both to indicate which type of evaluation is being described.

_____ 1. This type of evaluation is concerned with how students have changed as a result of instruction.

_____ 2. This type of evaluation is concerned with how students are changing as a result of instruction.

_____ 3. This type of evaluation assesses the degree of student learning of specific learning tasks.

_____ 4. This type of evaluation gives information on how instruction can be modified during the course.

_____ 5. This type of evaluation appraises the extent to which students have attained general course objectives.

In items 6-11 list the six possible uses of summative evaluation.

6. ____

7. ____

8. ____

9. ____

10. ____

11. ____

12. Which of the following is not a measure of the reliability of a test?

    a. a measure is taken to assess the consistency with which the test places students in the same relative position to other students onseveral administrations.

    b. a check is made to see if the same results are obtained on two items representing the same content behavior cell of the Taxonomy.

    c. a check is made to see if the results students get on two different tests are similar.

    d. a check is made to see if the students get the same score on a test when taken six months later.

13. Which of the following procedures weakens the objectivity of a test?

    a. a scorer removes facets of each test response which do not pertain to the purpose of an item.

    b. a scorer scores items as a result of knowledge of how the student does on other test items.

    c. argument among judges is sought to verify a particular score received on a test.

    d. errors in totalling the scores of all the items on a test are double checked.

ANSWERS

FORMATIVE QUIZ – UNIT 8

1. S
2. F
3. B
4. F
5. S
6. Assign grades
7. Provide feedback to students
8. Predict success in a subsequent course
9. Initiate point of instruction in a subsequent course
10. Compare outcomes of different groups
11. Certify skills and abilities
12. c
13. b

UNIT IX

IMPLEMENTATION OF A MASTERY LEARNING COURSE

OVERVIEW FOR UNIT IX

The first eight units of this workbook have focused on the necessary preconditions for teaching a Mastery Learning course; they have also focused on particular aspects of Mastery Learning theory, and on research that supports the mastery model as a viable teaching technique. This unit will focus on implementing mastery strategies in the classroom.

Writing orientation notes requires a thorough knowledge of Mastery Learning theory and the specifics of your mastery course, and so this precondition has been left until now. As the name implies, orientation notes serve as the students' introduction to the Mastery Learning approach to your course. We will discuss some ideas that may be included in the orientation notes to help your students immediately engage in the Mastery Learning process. Their engagement and active participation in the process are necessary if your students are going to succeed.

In this unit we will also discuss the City Colleges of Chicago's Mastery Learning Project, with emphasis on the support the project staff can provide to Mastery Learning teachers.

OBJECTIVES FOR UNIT IX

9.1 List the characteristics of an ideal course in your subject area.

9.2 Write a set of orientation notes.

9.3 Outline your implementation procedures.

9.4 Devise a homework assignment for each classroom period.

9.5 Describe the support needed to implement your Mastery Learning course.

THE IDEAL COURSE

The characteristics presented below are a compilation of responses teachers have made in informal discussions of the ideal course. Notice that the mastery strategy synthesizes these characteristics into a workable model. (Teachers who have had classroom experience should attempt to complete Exercise 9.1 before reading this decription of what an ideal course is.)

1. An ideal course will make it clear to everybody what the end product skill will be.

   If we want you to be able to pluck a chicken, sail a steady course, or juggle three balls and a dinner plate, we show you how and make sure that you have the end product visualized. We find resistance when we teach pure information for its own sake, without a clear picture of how it will ultimately be used.

2. An ideal course will let everybody know how the objectives are going to be tested.

   The more information we can give students about how they are to be tested, the more easily and quickly they can develop the required knowledge and skills.

3. An ideal course will take advantage of what students know and can do when they begin the course.

   We know how irritating and distressing it is to be instructed on how to do something we already know, or how frustrating it is to listen to a lecture going over our heads.

4. An ideal course will give the student as many choices of paths through the instruction as possible.

   The tendency to teach in the same order as we perform is strong, and yet a lot of enthusiasm can be dampened when we force students to put off parts that seem interesting so they can learn less interesting things first.

5. An ideal course will provide a range of software.

   One of the dogmas of the audio-visual business is that most of us learn best what we see, but the fact is we learn best in different ways. The challenge is to find the best alternative for each student.

6. An ideal course will allow enough time for any qualified individual to finish.

   An ideal system will give the students assurance that they have the time needed to read, ponder, practice, work out difficulties, look at other explanations, talk to other students, and whatever else they may need to do to learn.

7. An ideal course will provide a map to keep students informed about where they are in the system.

   It is a well-documented fact that the closer we are to the completion of a task, the harder we will work to finish it.

8. An ideal course will provide opportunity for practice of the skills being taught.

   In an ideal system, each prerequisite skill is taught before it is needed for subsequent learning tasks. This means that practice has to be built in along the way. That way we keep reducing the apparent complexity of complex tasks because they are always comprised of a number of things the student can already do.

9. An ideal course will provide regular and frequent feedback to students on their progress. This feedback should be provided in a non-punitive way.

   Students have to know how they are doing or else they might practice mistakes which will have to be unlearned later.

10. An ideal course accepts feedback from the students.

    A simple yet effective way is to place a "comments and suggestions" tablet in a conspicuous place and ask any student who voices a suggestion or complaint to jot it down.

11. An ideal course compares a student's performance to the objectives, not to the performance of other students.

    If we set our to teach students to write, and they do learn to write, we should acknowledge that they can write, without respect to what anybody else in the class did or did not do.

Exercise 9.1

List the characteristics of an ideal course in your subject area. This will meet Objective

DEVELOPING ORIENTATION NOTES

Orientation notes form a major part of your orientation procedures. They focus on how your students will learn for mastery. They concentrate on informing them about the various features of your strategy, and on pointing out the differences between the mastery approach and traditional teaching techniques.

The following list suggests some points you may want to include in your orientation notes.

1. The students are going to learn by a new method of instruction designed to help all of them learn well.
2. Each student will be graded solely on the basis of his performance on the summative examinations.
3. Each student will be graded against a predetermined performance standard and not in relation to the performance of his or her classmates. Indicate the standard for "A" work.
4. Each student who attains this standard will receive an A.
5. There will be no fixed number of A's. Accordingly, cooperation with classmates in learning need not hurt a student's chances of earning an A. If a student and his classmates cooperate, and all of them learn well, then all will earn A's.
6. Throughout the course, each student will be given a series of ungraded diagnostic/process tests to promote his learning. He should use the information provided by these tests to locate misunderstandings and errors in learning.
7. Each student with learning problems will be given a number of alternative learning procedures or correctives to help him overcome his particular errors and misunderstandings.
8. The student should use his choice of the suggested correctives to "correct" these errors and misunderstandings before they accumulate and impair his subsequent learning.

SAMPLE ORIENTATION NOTES

Following are two sets of orientation notes, which you may want to use as a model for your orientation notes. Examining these samples will help you write your own notes.

Course; Biology 101 SS
Instructor: A. R. Gallagher - Loop College
Class Sessions: Tuesdays and Thursdays
5:00 PM to 6:15 PM
Room 1030

Term: Fall 1978
18 week program
3 credit hours

Text: Introductory Biology, Jones and Gaudin, John Wiley and Sons, 1977.

Obtain your copy immediately from the bookstore directly west of the college or get one second hand from a last semester student.

Schedule: Class lectures and assignments are on separate sheets. Please keep these with you at all times as they give you the main units covered, and assigned readings, and will help you see the divisions of the weekly lessons.

Course Plan: A Mastery Learning approach will be used in this course. The objective is to have each of you achieve the highest mastery of the course material with the highest grade possible. The class meets twice a week with listed reading assignments done before each class, notes taken during the period and individual review and further re-reading done on your own.

At the end of each 2 week period (Unit) a Formative A quiz will be given covering that unit. If you have not sufficiently mastered the material from the quiz results, you will receive corrective exercises to assist you and sign up for a re-take or Formative B quiz.

A summative exam will be given at the end of two units of work following the formative quizzes. There will be four of these summatives given in the semester.

Homework Assignments:

These will be listed on your Lectures and Schedules sheets. Please follow them closely and read pages assigned prior to coming to each class.

Written assignments will be collected at the next class session. No late assignments please.

Formative A and B Quizzes:

These tests are used as diagnostic tools to help you pinpoint work areas. They will not be graded and your success on these tests should enable you to more easily master the summative exams upon which your grade will be based.

OBJECTIVES

Correctives:

Following your results on the Formative A Quiz you will be given a series of exercises for the areas missed. These correctives should strengthen your understanding of content and concepts.

Ability Checklist:

Concepts, terms, processes that you should be able to know or explain will be listed for you with each unit. You should know these for the summative exams.

Summative Exams:

These are four exams based on the semester course work. Your grade will be based on the accumulation of points from the four tests.

Grading:

Your grade will be based on the total points accumulated on all four summatives. The percentage scale used will be:

A	100% - 85%
B	84% - 70%
C	69% - 55%
D	54% - 40%

Absences:

Attendance is crucial! This course is very intensive in its plan to have you master Biology 101. If you can't put the needed amount of time in to succeed, please withdraw immediately as it will be difficult for you to keep up.

Study Groups:

Small groups will be set up at a time convenient for you to further develop your skill in Biology 101.

Success

Very much up to you. My role is to direct your learning. If you have never had Biology, or have had negative feelings about it in the past, we hope we can change that by the time you finish the course.

MATHEMATICS 103 SAMPLE ORIENTATION NOTES

Rosalind Cox
Malcolm X College

Rationale

The method of instruction in this course is called Mastery Learning. This is a relatively new teaching approach that was developed by Professor Benjamin Bloom at the University of Chicago. We believe that most of the students (at least 90%) in the Mastery Learning classroom can master the material presented and receive an A.

The following aids are to be used by the students in gaining success with Mastery Learning.

UNITS OF INSTRUCTIONS:

The course is sectioned into eight (8) instructional units.

ABSENCES AND TARDINESS:

Since this is a highly structured and very intensive course, students should attend every class session.

HOMEWORK:

Homework will be assigned, usually at the end of each class session. This work is to be done after class and discussed at the next class meeting. Students will be asked to work the assigned problems at the chalkboard.

DIAGNOSTIC TESTS:

Following the completion of each unit, a diagnostic quiz will be given. These will not count toward the student's final grade. Instead, the diagnostic tests indicates the student's progress in mastering the subject matter.

PARALLEL TESTS:

If you do not achieve mastery (85% correct) on the original diagnostic test, you will be required to repeat the test for that unit. You cannot take the summative exam unless you successfully complete the preceding make-ups. You can prepare for the parallel test in the following ways:

CORRECTIVES:

(a) Textbook. References pages are listed after each question.
(b) PLATO. The student computer terminal is located in the Learning Center 1SW.
(c) Tutorial Service. Tutors are provided by the staff of the Learning Center.
(d) Peer Groups. Small groups (2 to 4 students) of study buddies will be formed early in the course.
(e) Your instructor. See page one (1) for my office hours, or we can pre-arrange an appointment.

The student will have to make two copies of his answer sheet for the original diagnostic test. One of the answer sheets will be graded by you, the other will be turned in to the instructor.

SUMMATIVE EXAMS:

At the end of Unit Four (4), a summative (which is comprehensive) exam will be given to determine the student's midterm grade. It will also count for 50% of your final letter grade. A second summative exam will be given during finals week. This will count as the other 50% of your final letter grade. The grade range for the summative exams is:

88-100	A
75-87	B
62-74	C
50-61	D

POSTIVE MENTAL ATTITUDE:

By the proper usage of the above alternative resources, the student can achieve mastery of each unit and be prepared to attain mastery of the next unit.

Some students will need to devote much more time than others in mastering the early units, which develop the basic skills needed in algebra, but as the student builds mastery unit on top of mastery unit, the time required will greatly decrease for mastering later units.

If the student follows the prescription (correctives) at the end of each unit and puts in the time necessary to acquire mastery, a final grade of A is almost unavoidable. It's very possible for each and everyone of you to earn an A. Let's prove it!

Exercise 9.2

Develop a set of orientation notes for your mastery course. This will meet objective 9.2.

IMPLEMENTING A MASTERY LEARNING STRATEGY

Now that you have designed your Mastery Learning strategy, the next step is to develop a plan for implementing that strategy in the classroom. These are the steps that have been completed up to this point:

1. Identify countent outlines and learning units.
2. Develop tables of specifications.
3. Prepare instructional objectives.
4. Plan group-based instruction.
5. Construct formative evaluations.
6. Develop correctives.
7. Develop summative evaluations.
8. Establish standards for grading.
9. Develop orientation notes.

The next step is planning the implementation. One suggested pattern of implementation follows this outline:

A. Orientation
B. Teach each unit for mastery
    1. Present the objectives
    2. Make initial presentation
    3. Administer the formative/corrective/ retake cycle
    4. Certify each student's mastery of the unit
C. Administer the summative examinations

This section presents the details of this implementation and outlines some teaching techniques that have been shown to be effective.

Orientation

Because Mastery Learning is likely to be a novel experience for your students, some time should be reserved at the outset to orient them to your Mastery Learning strategy. This is especially important if it is likely that your students are not sophisticated classroom learners or if they have a negative affect toward school, themselves as learners, or your subject area.

An affective pre-test can be administered at this time. The information gained can be used to pinpoint affective problems some students may be having. If the teacher wants to test Mastery Learning theory's prediction that mastery strategies improve student affect, an affective pre-test should be administered at the outset of the course. (A sample affective test can be found in Unit X.) Otherwise, the pre-test can be omitted.

A cognitive pre-test also can be administered at this time. The information gained can be used to determine which cognitive prerequisites your students have and which they lack. In some evaluation designs used to determine the effectiveness of mastery strategies, (see Unit X for details) base line data is needed; a cognitive pre-test can provide that information. This pre-test is optional.

The orientation presentation focuses on two points: what the students will learn and how they will learn. One way to inform students about what they will learn is to hand out and explain a list of the course objectives. Another way is to hand out an alternative version of the summative examination.

The orientation notes developed earlier will help explain how the students are to learn. Some classroom time should be devoted to explaining in detail the Mastery Learning procedures that will be used. The oral presentation should emphasize that every student can earn an "A."

Teaching Units for Mastery

Presenting the Objectives. Begin by presenting your class with specific information about what they are to learn in the unit. One way is to hand the students copies of the Tables of Specifications devised in Unit III; in this case, the students should be given an explanation of the tables. Another would be to hand out the list of objectives you prepared in Unit IV. These objectives contain four major components:

1) Identification of the learner. An objective does not refer to the instructor who presents the material, but rather to the individual who is learning.

2) Description of the intended behavior, or a product of behavior. By specifying observable behaviors, you can reduce the ambiguity of instruction, clarify learning goals, and define what will be tested later.

3) The conditions under which the behavior is to occur. If the student needs special materials or resources not usually available, these exact conditions must be clearly defined in the performance objective. Remember, if the conditions are not specified, the performance objective implies that the student is to perform the behavior without any outside aids.

4) Performance levels to be achieved, in terms of both quality and quantity. A well stated performance objective specifies the minimal acceptable standard, or performance level, that the learner is to achieve. Such standards answer questions such as: What degree of accuracy must be attained? What percentage of the items must be identified?

(SOURCE: The League for Innovation in the Community College. Teaching in the Community Colleges: An Orientation. HBJ Media Systems Corporation. 1981.)

Handing out and explaining the unit's objectives is one way of letting the students know what they will learn in the unit. Other ways include:

1) A list of study questions. These questions should highlight the important content present in the assignment and indicate what the student should be able to do with this content — know it, comprehend it, apply it, etc. If there are many questions, you may want to organize them to provide natural breaks for the students; one way is to begin each question with a variation of this direction: "The following question(s) refer to pages ____ through ____ of the reading assignment."

2) General topic lists. These can be distributed to the students or written on the blackboard before class.

3) Ongoing summary sheets. These can help the students fit the new material in with the material they have already learned.

Whatever method you use to present the material to the students, however, the organization should be based on the organization you have already done by writing up the objectives and the tables of specifications. They are not substitutes for the detailed examination of the course the instructor does in writing up the objectives and the tables of specifications.

Making the Initial Presentation. Typically, this will be a group-based presentation. If the unit were two weeks long and the class met three times a week, this presentation would probably take four or five class periods. Follow the topical outline, but allow for the day-to-day exigencies of the classroom. If your plan is sound, you will always be able to return to it. We recommend giving a homework assignment each class period.

Following are some commonly-used methods of instruction which can be used in making this presentation. The individual instructor must decide which method or methods are appropriate for his or her students and the material in the unit.

LECTURES

Recommended Uses:

1. Introduce a new topic
2. Motivate students and arouse interest
3. Integrate and summarize material
4. Cover complex material
5. Share new information
6. Share the instructor's personal experiences
7. Provide enrichment experiences, such as guest speakers, films, and demonstrations

Advantages:

1. Economical in terms of classroom time, cost, and the number of students served
2. Provides exposure to knowledge not readily found in assigned readings or in the everyday experience of students
3. Can be used to present background material for new topics of study
4. A good vehicle for summarizing
5. Requires the least amount of energy to prepare and deliver, according to some instructors

Disadvantages:

1. The lecture tends to be a one-way process with students in the passive role; thus it is difficult to measure the level of student learning or interest while the lecture is being presented.

2. Lecturing forces all students to learn (or turn off) at the same pace, regardless of their abilities.
3. Students who do not listen or take notes well are at a disadvantage. Lectures should not take up the entire class time, particularly in long class periods.
4. Lecturing poorly facilitates certain types of learning, particularly problem solving, practical skills, and attitudes. Lectures seldom lead to the achievement of higher-level objectives, such as application, analysis, synthesis, or evaluation.

A Good Lecturer

A good lecturer does the following:

1. Obtains the attention of the audience at the start.
2. Makes the objectives of the lecture clear at the beginning, perhaps by listing them on the chalkboard or distributing handouts.
3. Follows an observable organizational pattern, e.g., spends 20 percent of lecture time outlining topics to be covered, 60 percent covering them, and 20 percent reviewing what was covered.
4. Includes no more than three major points per lecture, since that is all most people are likely to remember. When classes are longer than one hour, the number of major points could be increased proportionately.
5. Indicates the relationship of one subtopic to another.
6. Incorporates examples to illustrate new concepts.
7. Repeats main ideas in various ways.
8. Checks to determine where the listeners "are" by asking frequent questions to see if the students understand.
9. Provides audiovisual aids and printed handouts which give structure, guide the student to key points, or focus the learner's attention.
10. Pays attention to these public speaking points:
    a. Varies pitch and volume of voice.
    b. Looks at the audience.
    c. Avoids distracting mannerisms.
11. Projects warmth, friendliness, and self-confidence, as well as enthusiasm for the subject.
12. Uses humor, when appropriate, to create a warm atmosphere and to refocus students' attention on the subject.
13. Allows for audience participation by encouraging students' questions and paraphrasing their ideas.

Additional Tips for Lecturers

1. Summarize important points at the end of the lecture, perhaps by providing a handout.
2. Break up lectures with panels and other types of discussions. demonstrations, outside speakers, and audiovisual presentations (movies, slides, etc.).
3. Break the class up into rap sessions or task groups; research has shown that combining lectures and discussions is more effective than lectures alone for teaching comprehension and problem-solving skills.
4. End the lecture with questions to consider in the future.

DISCUSSIONS

There are three main types of discussion:

1. Problem-solving: For example, the members of a sociology class discuss how the problem of poverty in their community can be overcome. The steps involved are A) formulate the problem, B) search for solutions, C) evaluate the potential solutions, D) implement and evaluate solutions.

2. Open-ended: Students discuss thought-provoking questions related to their lives, the classroom, or any topic of interest. Open-ended discussions differ from traditional classroom discussion because the instructor is not looking for factual answers, but is trying to stimulate students to think about and relate what they know or feel about the subject being discussed.
3. Diagnostic: Instructors use these discussions to evaluate how well students have understood course material. In this method the instructor asks students questions directly related to what they have been studying.

Advantages and Recommended Uses:

1. Actively involve and challenge students
2. Give students opportunities to practice interpersonal skills
3. Gain acceptance for information, theories, and attitudes which are contrary to folklore or beliefs
4. Gain prompt feedback on how well course objectives are being attained
5. Help students develop higher-level cognitive processes, such as critical thinking and problem solving
6. Help students get acquainted with other students

Causes of Failure:

1. Discussion is easier for bright students than for less able students. If you use a discussion with less able students, structure it well and frequently summarize material covered.
2. A discussion is unpredictable, even when carefully organized. Participants can easily go off on tangents or become aimless, particularly when leadership is poor.
3. A discussion may become stilted and contrived if the leader has difficulty maintaining an open mind (i.e., if the leader knows what kind of answers he or she wants and will accept no others).
4. Some students may not feel confident of comfortable enough to participate.
5. One or several participants may dominate the discussion, with the rest of the students becoming uninterested spectators.

A Good Discussion Leader:

1. Plans the discussion and key questions.
2. Arranges the chairs in a circle to provide a more open environment and to encourage participation.
3. Provides a jumping-off activity to begin the discussion. For example, participants go on a field trip, read an assignment, or receive a description of the problem to be solved.
4. Clarifies goals and keeps the discussion moving. For example, the leader helps students to avoid diversions, points out stumbling blocks, and appraises progress.
5. Encourages student participation by reinforcing perceptive contributions and by asking open-ended and probing questions.
6. Refrains from judging student responses as right or wrong; accepts students' opinions as being worthy of further thought.
7. Gives help at appropriate times. For example, the leader rephrases questions for the group, suggests that members support their opinions, calls for and provides clarification of ambiguous contributions, occasionally summarizes material covered, and supplies missing information or refers students to sources where they can locate it.
8. Uses appropriate instructional aids, such as a chalkboard or an overhead projector.
9. Helps focus group conflicts so that they can contribute to learning. For example, the leader lists various points of view on the chalkboard.
10. Tolerates silence during a discussion. For example, the leader legitimizes silence by telling the group that an immediate response to a difficult question is not required.

11. Frequently summarizes key points to help participants see the progress made.
12. Evaluates, with equal emphasis, what happened in the discussion and how it happened.

Beginning the Discussion

1. Present a stimulating experience, such as a demonstration, film, or role play.
2. Pose a problem and ask students to identify as many aspects of the problem as possible.
3. Ask an open-ended question that gets students to think about relationships, applications, or the analysis of facts and materials.
4. Introduce a controversy, either by attempting to provoke students to disagree over an issue or by stating both sides of a controversial topic.

Barriers

1. Lack of information: Supply information which the students cannot be expected to have and which is needed to get the discussion moving again.
2. Ambiguity: Restate contributions that are unclear or ambiguous. In each case be sure to let the student who made the original statement agree with your interpretation or reject it.
3. Apparent lack of progress: Help the group chart its progress by summarizing or restating what has been accomplished.
4. Early closure by the instructor: Avoid telling the students the solution before they have developed some conclusions for themselves.

THE DEMONSTRATION/LABORATORY METHOD

Recommended Uses:

1. To teach manipulative skills, such as using equipment
2. To demonstrate scientific principles and theories
3. To illustrate the function or relationship of mechanical parts
4. To simulate interpersonal experiences in the behavioral sciences
5. To observe group interactions in a laboratory setting

General Procedures:

1. Plan the activity.
   a. Determine the purpose and objectives.
   b. Prepare a list of materials.
   c. Outline the steps to be followed.
   d. Determine how student performance will be evaluated.
2. Prepare for the activity.
   a. Set the stage (arrange seating, test equipment, etc.)
   b. Rehearse the demonstration; time the rehearsal (demonstrations should not exceed fifteen or twenty minutes).
3. Introduce the lesson; explain the demonstration's purpose and procedures.
4. Conduct the demonstration.
5. Repeat the demonstration if necessary.
6. Ask the students to perform.
7. Test the student's performance.

Procedures for Skill Training

1. Plan as described in No. 1 above. In addition, prepare a job analysis which includes a step-by-step description of what to do, how to do it, and key points to be covered.
2. Prepare, as in step No. 2 above.
3. Introduce the lesson; tell why the skill is important and how it will be taught.

4. Slowly preview all the steps to give students and idea of the task to be learned. You may want to write the steps on the chalkboard or prepare a handout.
5. Demonstrate the skill slowly, explaining the purpose of the steps and the relationship between them. If the students are beginners, you may want to do this twice. Discuss points of safety, and give small amounts of key information and theory as you demonstrate. Use audiovisual aids when needed — for instance, to enlarge small parts of machinery so they can be seen.
6. After each major step of the demonstration, ask questions about the step and the relationahip between steps.
7. Based on student needs, provide repetition such as the following:
    a. Repeat the demonstration at a faster speed.
    b. Have the students demonstrate.
    c. Demonstrate variations of a technique.
8. Guide each student through an initial correct performance. Often you may need to assign work to students, get them started, and then correct any errors or provide additional instruction on an individual basis. Students should not be allowed to practice incorrect methods.
9. When learning skills, the student must practice the physical and mental steps until the process becomes automatic. Plan your schedule so that eachs tudent can practice with the equipment as soon after the demonstration as possible. Provide feedback.

OTHER POPULAR TEACHING METHODS

Role Playing

Usually without a script, class members enact problem situations in human relations. The role playing scene is followed by group discussion; then the scene may be replayed using different participants in the roles. Role playing provides a close-to-reality base for personal understanding and insight and for group discussion, problem solving, and human relations training.

Discovery Learning

Discovery learning is based on inductive reasoning. After being presented with a number of examples, the learner is required to arrive at a general rule or principle.

Buzz Groups

The class is divided into subgroups; each group is given a series of questions or problems and asked to come to some kind of consensus. After one class period or several, the subgroups report to the class; comments and discussion from other students are welcomed. Often the groups write reports.

Simulations

Simulations are contrived experiences designed to approximate real experience. Sometimes simulations use models, such as a full-scale replica of an airplane cockpit. At other times, a realistic problem is posed and students are asked to act it out and solve it. For example, students solve an environmental problem as they play the roles of manufacturers, company executives, members of an ecology group, and concerned citizens. Simulations emphasize the process or task; by contrast, role playing stresses human relations.

Peer Teaching

Students help other students learn. Two examples are described below:

Teacher of the Day: Students are divided into several small groups. On a given day, one of the members of each group teaches; all groups work on the same topic. To insure that quality instruction talkes place, the instructor closely monitors the work of the student teachers.

The Learning Cell: Students are grouped in pairs. After reading an assignment on his or her own, each student prepares questions about the content of the assignment. The pairs of students take turns asking each other their questions. The instructor collects copies of the questions and provides feedback about them. To help maintain interest, pairs should be rotated periodically.

ADAPTED FROM: The League for Innovation in the Community College. Teaching in the Community Colleges: An Orientation. New York. HBJ Media Systems Corporation. 1981.

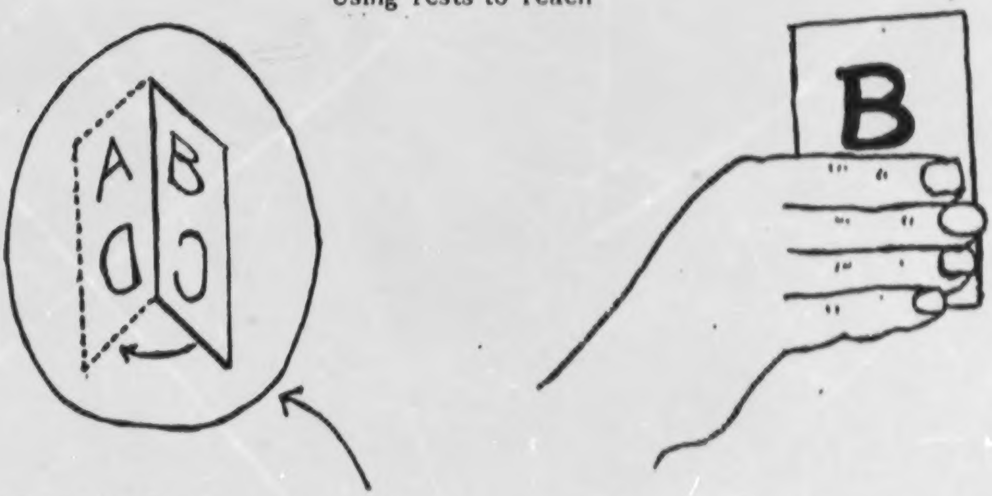
Administering the Formative/Corrective/Retake Cycle. Once the initial presentation on the unit's content has been made, administer the formative evaluation. Do not move on to the next unit. The formative evaluation is designed to be an integral part of the teaching-learning process; it provides immediate and regular information regarding the students' progress during — not after — instruction. The instruments are brief, so that they do not take up inordinate amounts of instructional time. They are diagnostic: each formative tests those skills students must learn from a given unit if they are to master the course objectives. Administered at the close of a unit, the formative provides an in-depth picture of what the student has and has not learned. It suggests portions of the initial presentation that can be improved.

Formative evaluations will perform their function better if students are given immediate feedback about their performance. If at all possible, the formative should be scored during the same class period in which it was administered. Each student can score his or her own paper, or an automatic scoring machine can be used. Give each student an answer key, or read the correct answers to the whole class.

Dr. Bruce McDonald of Southern Illinois University has designed one very quick way of administering a formative test. His description of the technique follows.

GROUP RESPONSE TESTING

Using Tests to Teach



MATERIALS REQUIRED

1. One 5x8 card per student, marked with color-coded responses (A,B,C,D).
2. Any multiple-choice, true-false, or matching questions which can be administered visually (paper, flip chart, overhead projector).

HOW DO YOU USE GROUP RESPONSE PROCEDURES?

1. Hand out the test or show the items one at a time.
2. Ask the class to respond with their choices to each question. Because of the color-coded letters, you'll discriminate between responses easily.
3. Announce the correct answer if you are checking their recall, or, say that you'll tell them the answer later if you want a discussion or if the answers are based on experience or judgment.
4. Discuss the answers if necessary. Begin with correct choices, asking for reasons, and then ask for the reasons for the incorrect responses. Usually the students see their errors immediately, however.

WHY USE THIS TECHNIQUE?

1. Immediate reinforcement of correctness (with satisfaction).
2. Immediate correction of mislearned or misunderstood materials.
3. A non-threatening atmosphere is established in which the focus seems to be on learning.
4. Greater discussion ensues, since the students don't have to defend choices.
5. Less boredom since you only go through a test once (unlike pop tests).
6. You can use your unusable question from a test pool. The too easy ones now will serve to promote discussion.
7. Since the questions don't have to be of high quality, you can produce them quickly and in large number.
8. You can check for the completion of reading assignments or for attainment of your objectives each class period.
9. Students enjoy the process.

Identify those students whose performance meets or exceeds your pre-set standards for mastery on the formative. We recommend publicly congratulating these students, singling out for special praise those students whose formative quiz performance has heretofore been unsatisfactory. Certificates of Mastery can be used.

Students whose performance does not meet your standards for mastery should be assigned correctives at this point.

To promote student learning to the fullest extent, the diagnostic information provided by the formative evaluation must be translated into specific supplementary instructional procedures whereby each student can correct his or her particular learning difficulties. Specific corrective activities should be developed for each item on the formative. Then, each student does only those activities he or she needs to in order remediate his or her specific learning difficulties. Alternative activities should be selected or developed for each item of the formative. In this way each student can select the activity that best suits his or her leaerning styple. Correctives are discussed in Unit VI of this workbook.

At first it may be necessary to monitor the corrective process closely. Using small-group study sessions during class time or immediately before or after class will make it easy to monitor student activities. As the students gain some familiarity with the corrective process less monitoring will be needed.

The major intent of the formative evaluation and the correctives are to pinpoint and correct student learning deficiencies before they impair subsequent learning. To determine whether this goal has been attained, the retake evaluation is administered after students complete their correctives. This instrument tests for mastery of the same skills that the unit formative did. To avoid students merely memorizing the correct answers, different test items are used.

The retake can be administered to all students in the class, or only to those who did not meet your standards for mastery on the unit formative. The retake can be administered in class, or individual appointments can be made with each student.

If the student's performance on the retake indicates that he has adequately learned the content of the unit, then praise him privately. Also, praise him publicly at the outset of the next class period. This will help reinforce the idea that satisfactory learning is satisfactory learning and that it is recognized as such, regardless of when it is attained.

This completes the implementation cycle for one unit of instruction. The pattern is: present the unit objectives, make the initial presentation of the unit's content, administer the formative, assign correctives as needed to those students who need them, and certify mastery of the unit's objectives with the retake.

The most important difference between this pattern of teaching and traditional approaches is the formative/corrective/retake cycle. Given the already limited amount of instructional time available, these additional activities may seen to impose an unacceptable burden. However, note that the correctives, except for possibly the correctives for the initial units of instruction, can be done outside of the classroom. The retake can also be done outside the classroom and some teachers have even administered the formatives as take-home quizzes. If the formatives and retakes are scored but not graded, as we advocate, then there is little motivation for students to be dishonest. Further, recent research by Block and others suggests that if more instructional time is set aside for earlier units, then less time will be needed for the later units. The total instructional time spent for a course under this arrangement will be no more -- and possibly less -- than would have been spent under traditional systems.

Administering The Summative Examinations

At one or more points in the course the regular implementation cycle for the units is interrupted to administer a summative examiniation. These instruments are used to evaluate how the student has changed. They are used to determine whether the student has achieved mastery of the major course objectives and goals, and to assign grades. Details concerning summative examinations can be found in Unit VIII of this workbook.

Exercise 9.3

Develop and outline of the implementation you will use for your Mastery Learning course. This will meet Objective 9.3.

HOMEWORK ASSIGNMENTS

Homework assignments should be planned so that they give students an opportunity to practice the skills he or she will need to meet the objectives of the course. There should be a direct correspondence between the objectives, the classroom presentation, and the homework assignments.

Homework should be meaningful to the student. That is, the student should be able to grasp relationships between facts, generalizations, rules, and the task they are asked to complete. Avoid busywork, homework for the sake of homework.

Homework should have clear instructions, so that students can do the assignment at home, without further help from the teacher. It should also be within the students' ability to complete, so that they do not become frustrated. If you have any doubts, set some time aside during the class period to start the assignment and answer any questions that may arise.

Students often regard a reading assignment as no assignment at all. If a reading assignment is the appropriate homework assignment, also assign questions about the reading, or some other task that requires the student to use the facts and ideas presented in the reading.

Homework assignments can be added to the topical outlines described in Unit I.

Exercise 9.4

Develop a homework assignment for each class period of your course. This will meet Objective 9.4.

CITY COLLEGES SUPPORT SERVICES

A teacher who is implementing a mastery course, especially for the first time, may feel the need of some assistance and guidance. The following is a description of the support which is available at the City Colleges of Chicago, both at the local campus and system-wide.

Each campus has its own coordinator, a Mastery Learning teacher who acts as a liaison between the Mastery Learning Project Director and the teachers on the local campus. These coordinators recruit Mastery Learning teachers, distribute supplies, and ensure that teachers receive the credits they have earned for participating in Mastery Learning workshops and seminars. They also distribute information to students and teachers using Mastery Learning techniques and consult with campus adminstrators to explain the Mastery Learning approach.

The Mastery Learning Project provides support system-wide. It conducts workshops in Mastery Learning, for which participants receive lane promotion credit. The Project has assembled this workbook to aid teachers in the preparation of their course. It has also held annual Mastery Learning conferences for educators from around the country. On an on-going basis, the Project also provides supplies to campuses and publishes a newsletter.

One service which the Project provides that may be of particular service to a Mastery Learning teacher is the Mastery Learning Library, which contains copies of mastery materials developed by CCC faculty. Even if no one has developed materials for the particular course an instructor wants to teach using the mastery strategy, he or she will probably find that many of the materials already developed can be readily adapted. In addition, through the years, the Project has acquired a number of books, articles, and dissertations on Mastery Learning, and these are also available through the Project Library.

Exercise 9.4

Describe the support needed to implement your Mastery Learning course. This will neet Objective 9.4.

Formative Quiz - Unit IX

List five of the planning components or pre-conditions necessary for implementing a Mastery Learning course.

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________

6.___ Which of the following elements would not necessarily be a part of an orientation to Mastery Learning?
   a. discussion of how Mastery Learning differs from coventional teaching and learning techniques
   b. a motivation talk persuading students they can "master" course learning tasks
   c. a discussion of Bloom's Taxonomy
   d. presenting course objectives and grading procedures

7. Typically, increased achievement of students is used as a measure of the impact of a particular teaching method. What other major index does Bloom indicate should be used to measure the impact of Mastery Learning?

____

____

List two other indicators of changes in learning effectiveness.

8. ____

9. ____

10. A major concern of Mastery Learning theory is to determine the best educational outcomes.

____true ____false

11. A major concern of Mastery Learing is to insure equality of educational opportunity.

____true ____false

12. How does Mastery Learning deal with errors in learning?

____

____

13. If Mastery Learning works, educators will find it necessary to ask whether the time and effort required to learn a subject to a high level can be justified for particular students.

____true ____false

ANSWERS

Formative Quiz - Unit 9

ANY OF THE ALTERNATIVES BELOW COULD BE USED TO ANSWER ITEMS 1-5.
-developing topical outlines and learning units
-building tables of specifications for each unit
-preparing behavioral objectives
-constructing formative evaluations
-developing corrective learning processses
-developing summative evaluations

6. C

7. decreased variablility of achievement

ANY OF THE ALTERNATIVES BELOW COULD BE USED TO ANSWER ITEMS 8 AND 9.
-degree of involvement
-time-on-task
-rate of learning

10. false - Mastery Learning is concerned with processes of learning.

11. false - The equality of educational outcomes is the major goal.

12. Through a system of feedback to the teacher and student, errors are revealed. Appropriate correctives are introduced so that errors are not compounded.

13. true.

UNIT X

EVALUATING MASTERY LEARNING AND YOUR MASTERY LEARNING COURSE

OVERVIEW - UNIT X

In this unit we present a critique of Mastery Learning as an educational theory and as a teaching strategy. This critique includes considerations of Mastery Learning's philosophical assumptions, its educational assumptions, and its ability to be successfully implemented. We will consider Mastery Learning's history, its contributions to the field of education, and its specific strengths and weaknesses. We will compare Mastery Learning to Keller's Personalized System of Instruction and to other more "traditional" techniques.

Mastery Learning has demonstrated the ability to survive the test of time and of continuous investigation. It was one of many innovative learning strategies developed during the 1960's, though it may be more appropriate to say that it was re-discovered rather than developed. Unlike many of the others, Mastery Learning has continued to enjoy strong support. Its progress has been characterized by continuous contributions to basic and applied research.

Mastery Learning has been shown to be effective in many experiments conducted in situations ranging from the elementary grades to graduate school. While this is certainly comforting, Mastery Learning must work in your classes if it is to be valuable to you. Hence, this unit also offers some suggestions and some guidelines that you can use to evaluate the effectiveness of your Mastery Learning strategy.

This unit will also discuss ways in which you can measure the affective consequences of your course. A student's affective characteristics are those attitudes he has toward the subject, toward school in general, and toward himself as a learner. These affect how well he performs in a given course and, in return, how he performs in a given course affects his attitude. This unit will show you how to measure the affective consequences of your course.

In this unit you will construct an affective instrument for your course and develop a method of evaluating your mastery class.

OBJECTIVES - UNIT X

10.1. Critique Mastery Learning by defining its contributions, strengths, and weaknesses.

10.2 Construct a test to measure the affective consequences of your course (optional).

10.3 Compare your teaching of your mastery course with your teaching techniques before using mastery.

10.4 Describe how you will evaluate your mastery class.

EVALUATING MASTERY LEARNING

Since Bloom formed his model for Mastery Learning in 1968, many people have debated the advantages and disadvantages of the system. The articles which follow will present much of this discussion.

John Dolly and Vana Meredith, in their article on Mastery Learning as a classroom management tool, present some of the common misconceptions about Mastery Learning. A rejoinder to the points raised in the Dolly and Meredith article has been included.

Also included in this section are a functional analysis of Mastery Learning by Lorin Anderson of the University of South Carolina, questions and answers by Dr. Rocco Caponigri reviewing the major features of Mastery Learning, an outline of the strengths and weaknesses of the system, and a discussion of the implications of Mastery Learning.

THE USE OF MASTERY LEARNING AS A CLASSROOM MANAGEMENT MODEL

John R. Dolly and
Vana H. Meredith

This article deals with Bloom's (1968) model of mastery learning as a classroom management technique. An attempt will be made to point out some of the weaknesses of the model and also to describe how the model is misinterpreted and misused. Within the mastery model there are no specific guidelines, only broad general categories indicating what the model calls for. Like other instructional models the mastery learning model provides only a broad outline of steps to be followed in achieving the goal of mastery. Only in the area of evaluation does the model specify how to actually carry out the procedures outlined.

In the areas of preplanning and instruction the model is also inadequate. It assumes skills and knowledge on the part of teachers not normally provided in teacher training programs.

The model basically provides an outline of procedures that may be implemented at various stages in the instructional process. This outline can be considered a management tool that provides teachers with a list of possible strategies for preplanning, teaching and evaluating within a classroom environment.

Instructional Planning

The model talks of preconditions. It assumes that teachers have a wide variety of skills that will enable them to pre-plan instruction for individual learners. It also assumes teachers have skills in developing criteria that represent true mastery. In basic skills this assumes that teachers can write and use instructional objectives. The model assumes that these are clearly stated before the teacher attempts to implement the model. The model also assumes that the teachers have skills in designing instructional units using a wide variety of approaches and materials. And finally it assumes teachers can develop large numbers of valid test instruments to be used throughout the instructional sequence. There are few classroom teachers that would be able to demonstrate skills in all these areas.

These skills could be classified under instructional design. Mastery learning requires more pre-planning and a wider range of instructional skills than do most models. It appears that if teachers do not adequately prepare the learning environment, mastery will not happen. One of the major problems would be to convince teachers that it is more important to spend a large portion of time pre-planning instruction instead of spending the time actually teaching.

Teaching Strategies

The model talks about operating procedures. Here Bloom does specify how to establish a meaningful evaluation system that provides a constant flow of feedback information to student and teacher. This is the major advantage of the model. However, the model does not deal with instructing or teaching. It merely suggests some things teachers might try. Most teachers, though, are far more concerned with teaching techniques than they are with evaluation procedures.

For the model to be of use to most teachers, specific teaching strategies would need to be recommended. Examples actually demonstrating implementation of the strategies could be given so teachers could see for themselves how the model might work in a real classroom. When Bloom does talk about various strategies, he simply lists them -- suggesting that teachers try them all and use whatever works.

Proposed Outcomes

Finally, the model talks about outcomes. It assumes that students will develop cognitive skills by being prodded to achieve mastery. As a result of these cognitive skills the student has developed, he or she will also develop a more positive self-concept and a more productive attitude toward learning. This is plausible if in fact the student does achieve mastery. If, however, a student spends an inordinately large amount of time to achieve mastery, we are not so sure his self-concept will improve. Students will still make some comparisons among themselves, no matter how their activities are structured. When a student is aware of the fact that it is taking him three or four times as long as his classmates to learn something, this knowledge is probably going to affect him.

In the model, Bloom never really deals with one problem of meaningful standards to represent mastery. This is an important component of the model that has not been given adequate treatment. Before implementing the model the teacher must decide what constitutes mastery. To simply state that a score of 90 or better on a classroom test equals mastery is not sufficient.

Instruction vs. Teaching

As mentioned previously, the original mastery learning model never dealt with implementation on a practical level. The model suggests what to do if things go wrong, but it's far from prescriptive. Bloom tells us that if a student does not achieve mastery we should then go to alternate learning procedures and resources. Unfortunately, he does not tell us specifically what to do with these alternatives. There is an implicit assumption that teachers know what these alternatives are and how to implement them. We doubt very much that this is true. Most teachers are proficient in doing things a particular way. When we suggest alternatives, they want more information than just listing these options. Teachers want specific information on "how to" use these procedures. Without this type of information most teachers, even if aware of alternative procedures, may simply be unable or unwilling to actually try and use them. What teachers want are models of teaching, not models of evaluation or instruction.

The Problem of Time

If mastery learning were to be implemented, then theoretically each student would work at his or her own level of performance in each academic area. Since you would have a certain number of students at each level, you would tend to group these students at their various levels. Students would be working primarily with other students on their own level of functioning. The purpose of the grouping is to reduce the time needed for some students and increase it for others. The assumption is that if given enough time even those students at the low end of the distribution will be able to achieve mastery in various academic skills. Within most educational settings the largest number of problems occur with the slow student. In the mastery system the bright student would continue to achieve and would probably accomplish a great deal more, since he would no longer be held back by the slow learner. The slow student would be given the time to learn low-level prerequisite skills, so he could then go on and achieve mastery in a subject. This is the way our schools should work if we are really concerned that our students learn at least basic skills. One important point to remember, however, is that the real world (outside school) operates on a norm-referenced system. Students who learn faster will get hired ahead of slow students. Entry into jobs, industry and professional schools is based on rank order and on time. In our society time is an extremely important factor. Judgments are often made on the basis of time. People who do things in short periods of time are usually the people who are rewarded. If two people are able to demonstrate some skill to the same degree of proficiency, we as a society tend to label the person who can demonstrate the skill within the shortest time frame as the best of the two. Somewhere in the mastery system students need to be made aware of how they stack up relative to the others with whom they will eventually be competing. As Gardner (1961) points out, teachers do not like to evaluate students-and try to get around it anyway they can. Teachers, however, have a responsibility to be truthful to students and to let the students know their weaknesses as well as their strengths.

Relative vs. Absolute Standards

The assumption that absolute rather than relative standards of performance will actually improve student performance is questionable. There appears to be a general movement in education today toward criterion-referenced measurement. In many schools children are no longer graded in accordance with their position in a group but are instead given grades based on their individual achievement. A grading system that assigns A's on the basis of individual achievement causes similar problems to the system which assigns A's on the basis of class ranking. A student who gets an A for his individual effort may have fewer skills that a student who received a B because he simply didn't try hard enough for the teacher. When grades are assigned on the basis of student motivation (a subjective evaluation by the teacher) or on the basis of individual achievement they are essentially worthless. They do not tell the student, teacher or parent exactly what it is the student is able to do. Bloom's solution to both problems would be to go to a criterion-referenced system where students would be required to demonstrate a skill or series of skills before receiving a grade. This argument sounds logical, but it rests on the assumption that we will finally agree on meaningful standards for our schools.

Bloom's criticism of the norm-referenced system is perhaps a bit over-played. Bloom argues that the only "good" grades are A and B in our society; yet our norm-referenced system allows only a small portion of the students in a class to receive these grades. This probably true; however, we would contend that the primary reason C is no longer respectable is because teachers rarely give out a C or D or F. Teachers are so concerned with social promotion that everone seems to be getting A's and B's for their individual effort rather than their performances. The point is that the criticism against a norm-referenced system is really a criticism against a misuse of the system.

One of the major criticisms of the norm-referenced system is the fact that the A or B really indicates only rank in a small group. The grade in no way tells you what the student can do. Also, the grade of D or F in one school could possible be an A or B in another. This is certainly true. This points out the fact that there are differences among and within regions concerning the performance and abilities of their students.

Bloom proposes that we set a criterion for mastery and assign a grade of A to a student when he or she achieves this level of mastery. Can we really do this? We can probably establish criteria for a school district. It is doubtful that we could come up with agreed upon criteria for an entire state. Within each school district students would work toward mastery; and when they achieved it, they would get an A. Unfortunately, we are back to square one, where the A in district #1 does not necessarily equal the A in district #2. One solution might be to go to statewide standards or even national standards for mastery. But if we did this and then established the criteria of mastery as the national average, on a test we would have at least half our children, school districts and states unable to achieve the criteria. This initial difference would not be permanent. If the criteria remained fixed rather than relative, eventually most children and schools would reach it. But even if we have fixed national criteria, some students and schools would achieve the criteria in short periods of time and would far exceed these minimum requirements while other students would barely make the criteria given long periods of time.

One possible solution is to get away from the notion that mastery equals A. Do away with the grades altogether. This is the suggestion we find most appealing. Instead of grades, provide students, parents, teachers, etc., with statements of student abilities and performances. This eliminates the use of a worthless grade and provides far more information to everyone concerning students skills. Even without grades we will have a norm-referenced system. Some students will be more proficient that others and some will reach mastery sooner than others. This is probably what Bloom had in mind when he developed the model. The problem with using the grade of A is its misuse by educators. Teachers concentrate on trying to have their students achieve A's for mastery instead of concentrating on skills their students need to learn.

Misuse of the Model

The mastery learning model lends itself to misinterpretation and misuse by being too simple and by emphasizing the evaluation aspect of learning. The emphasis on everyone getting an A is very appealing to teachers who see mastery learning as a solution to their problems. What some teachers fail to realize is the absolute nature of a mastery system. There can be no social promotion. The standards once established must be adhered to for the system to work. If a student fails early in the system, he must repeat that unit until he or she masters it before moving on. The asumption is that if students spend a great deal of time actually mastering the prerequisite skills needed in an area, they will then be able to go on to the more complex tasks and accomplish these tasks at a specific level of mastery. Instead of maintaining the high standards, however, teachers often lower the standards so more students can achieve mastery and get their A. The standards are sometimes lowered by actually teaching to the summative test.

The mastery model assumes a degree of sophistication in test construction skills lacking in most classroom teachers. To develop good formative and summative tests, teachers need to be able to write or select appropriate instructional objectives and then sequence these objectives.

Teachers also need to be able to write valid test items that sample their instructional objectives. Unfortunately, very few teachers are required to take a course in test construction and measurement. This would mean that most schools would have to provide a resource person trained in test construction and instructional design to help the teachers develop their materials and tests.

Related to the test construction problem is a lace of knowledge about tests in general. We have seen college teachers interpret mastery learning as allowing students to retake the same test over and over again until they pass it and get their A. We are sure this is not what Bloom had in mind.

Teachers also attempt to use a mastery system without making any attempt to provide individualized pacing of instruction. Allowing students enough time to learn is the key to mastery. Teachers, unfortunately, ignore this factor and attempt to implement a mastery program where everyone works for the same amount of time (usually a semester) and everyone miraculously gets a grade of A. What teachers seem to be attempting might best be described as a part-time mastery system.

Summary

This presentation has attempted to show that there are some major complications when teachers attempt to implement a mastery leanring model.

The model is attractive to educators because of its apparent simplicity. This simplicity is deceiving. In fact, the model requires that teachers have a variety of skills in addition to competence in their own content areas. The model itself provides an outline of procedures to follow, but never deals with the actual implementation on a practical level. By appearing to be simple and by emphasizing the evaluation aspect of learning, the model lends itself to misinterpretation and misuse.

FROM:

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Rejoinder to "THE USE OF MASTERY LEARNING AS A CLASSROOM MANAGEMENT MODEL"

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While the article by Dolly and Meredith contains a number of salient points, these points are interspersed with misconceptions. Below are some of these misunderstandings, along with an explanation of why we believe they are false.

Dolly and Meredith state that few classroom teachers would be able to demonstrate skills in all the areas necessary to make the Mastery Learning model functional -- areas such as planning individualized instruction, developing criteria for mastery, writing instructional objectives, and designing valid test instruments. Most City College faculty, in the contrary, do possess these skills, at least to some degree. If they have not picked up these skills through graduate course work, they have developed them through the experience of preparing and teaching their own courses or learned them through interacting with their colleagues. Also, in recent years many in-service programs have attempted to develop or improve the skills that Dolly and Meredith suggest are weak or lacking.

Dolly and Meredith also believe that it would be a major problem to convince teachers to spend more time planning a course. We ;have found that the amount of time devoted to preparation or preplanning varies, depending on the subject matter and the teacher involved. The time that an individual teacher spends in planning a Mastery Learning course may or may not be significantly more than the the time he spends in preparing a traditional course. It is true that in a Mastery Learning course, teachers are asked to develop units, Tables of Specifications, objectives, formative tests, correctives, retakes, and summative tests; however, in many cases, these are merely new names for activities which teachers are presently doing. Furthermore, developing a mastery course may actually save time in the long run, since once the mastery course is planned, the teacher may have to spend less time in revising the course each year. The structure of Mastery Learning clearly points out the areas of difficulty, thereby allowing focused and specific revision.

Block and Anderson suggest some ways to cut the workload involved in the initial preparation of a Mastery Learning course in their handbook, Mastery Learning in Classroom Instruction:

1. Do not develop the whole mastery course at once; develop one or two mastery units each time.
2. Team up with a colleague and develop a Mastery Learning course together.
3. Find textbooks which are similar to your own, but which use Mastery Learning techniques.
4. Borrow and then modify an existing teacher-made Mastery Learning strategy.
5. Adapt an existing commercial Mastery Learning strategy.

Dolly and Meredith suggest that Bloom's Mastery Learning model is overly concerned with evaluation, while teachers are more concerned with teaching techniques. In our experience with City College of Chicago faculty we have found that teachers are committed to their own teaching techniques. Therin lies the strength of the Mastery Learning model, since it can adapt itself to a variety of techniques. It is incumbent upon those of us in Mastery Learning to demonstrate that only through evaluation, re-evaluation, and modification can teaching improve.

Dolly and Meredith argue that when Bloom talks about various strategies for implementing Mastery Learning, he merely lists them, "suggesting that teachers try them all and use whatever works." It appears to us that most teachers understand the suggested uses of peer tutoring, small group tutoring, and alternative textbooks, and can determine how to incorporate these suggestions into their own classrooms, which necessarily differ from place to place. Since most instructors do understand the general uses, Bloom does provide enough guidance to implement his strategy. Furthermore, most teachers need to convince themselves of the techniques and strategies which will work in their own situation.

Dolly and Meredith point out that a student might be adversely affected by the knowledge that it is taking him three or four times as long to learn something as it takes his classmates in a Mastery Learning class. But surely students are far more affected in a traditional classroom by knowing that they are not learning as much as their classmates. In a traditional model, the assumption is that students either have the innate ability to do the school work or they don't, and that there isn't much that a student without the ability can do about it. In a mastery model, on the other hand, assumption is that there are some students who learn faster than others but, by increasing the kind and quality of instruction, all students can learn what the school has to teach. The slower student can learn as much as the faster student if he persists. And persistence and diligence may, after all, be more valuable traits to develop than the concepts taught in any particular course.

Dolly and Meredith express some concern that the criteria for mastery might arbitrarily be set as a score of 90 or better. No one in Mastery Learning suggests that teachers set their standards this way. Usually standards are set by examining the past performances of similar classes or by determining what the student needs to know in order to go on to the next course or to be certified in a given area. Through constant review and modification, these standards for grades become increasingly valid.

In the section labeled "Instruction vs. Teaching," Dolly and Meredith again bring up the claim that Bloom had not explained alternative teaching strategies fully enough for teachers to be able to implement them in their own classrooms. They suggest that teachers are not flexible enough to be able to be seek out or implement these strategies on their own. Our experience has been that teachers vary; some are committed to the traditional process, while others are willing to try a variety of techniques.

The alternatives for instruction vary, depending on the teaching environment. The teacher in a school without many resources may have little alternative but to ask the student to repeat the material, while an instructor at a large university may be able to suggest alternative textbooks, videotaped reviews, computer-supported instruction, etc. Any list of alternatives would be incomplete, and supplying them may be more a function of an in-service at the particular institution than of a model meant to serve in a number of teaching systems.

Dolly and Meredith seem to believe that the implementation of Mastery Learning would result in tracking, in separating student by ability. In the City Colleges system, though, students do not have to be grouped by ability, however, since the formative/corrective/retake cycle tailors the instruction to the student's individual needs. The faster student can be involved in enrichment activities while the slower ones use correctives which are matched to their own problem areas.

Dolly and Meredith contend that the real world operates on a norm-referenced standard. In many cases this is so. However, when the outside world engages in training, it usually operates on an absolute basis. For example, typists, bank tellers, doctors, lawyers, and others too numerous to mention are all trained to a high level of proficiency. It is true that people in these occupations tend to be rank-ordered by speed and proficiency, but they are all required to demonstrate high levels of performance before they are certified.

Dolly and Meredith suggest that teachers be truthful to students and let them know their weaknesses as well as their strengths. We say that the teacher's primary responsibility is to develop each student to his full potential. For too long, schools have been convincing students that they can't learn. Our experience with Mastery Learning has shown that, with the proper prerequisites and the proper teaching techniques, most students can learn to a very high degree what the schools have to teach.

Dolly and Meredith favor doing away with grades altogether. There appears to be little enthusiasm among educators for this proposal, and experiments with alternative evaluation techniques have not been very successful. The idea of classrooms without grades might be forthcoming, but doesn't appear to be on the near educational horizon. Furthermore, students have been conditioned to expect grades, and we suggest that, used appropriately, they can be a source of motivation for subsequent learning.

Dolly and Meredith contend that teachers in mastery classes often lower their standards so that more students can achieve mastery and get their A. Certainly, no one in Mastery Learning advocates this. Besides, in our experience at the City Colleges of Chicago, we have found that the opposite is often true. Frequently, teachers new to Mastery Learning set higher standards for their mastery classes than the standards they used prior to adopting mastery techniques.

In "Misuse of the Model," Dolly and Meredith again come back to their contention that teachers are lacking in skills -- this time in the area of test construction. They say that few teachers have been required to take courses in test construction and, therefore, they have difficulty constructing valid test items which sample their educational objectives. Our reply to that is the same as our reply to their contention earlier that most teachers lack skills in such areas as writing educational objectives. In our experience with City College faculty, we have found that most teachers do have these skills, acquired either through education or experience, and that there are in-service programs to improve these skills if necessary.

Dolly and Meredith state that some teachers interpret the formative/retake cycle to mean that they should allow students to continue to retake the same test over again until they earn an A. This is not what Bloom had in mind and, in our experience, teachers do not interpret the formative/retake cycle this way. If this misinterpretation does arise, those of us who are involved in Mastery Learning should point out the necessity for correctives to help students with their particular difficulties and for alternative retake tests. These alternative retakes are parallel but not identical to the original formative test.

Finally, Dolly and Meredith suggest that what actually occurs in the classroom is "part-time" mastery, since students all work for the same amount of time and "everyone miraculously gets an A." In a real mastery class, they contend, the time would be varied to suit the student's individual needs. In Carroll's model of school learning, though, the time spent in learning is affected by two factors; the time allowed for learning to take place and the time the learner is actively engaged in learning. While, in a system such as that used by the City Colleges, the number of contact hours remain the same, the time actively spent in the learning process increases. With the formative/corrective/retake cycle, the student can concentrate on those portions of the unit which he has difficulty with, rather than listening to a generalized, and partially irrelevant, review.

A FUNCTIONAL ANALYSIS OF MASTERY LEARNING

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Both Mastery Learning programs and criticisms of them are proliferating at an astounding rate. Unfortunately, many advocates and virtually all critics have different interpreatations of what Mastery Learning (ML) is and is not. As a result, serious disputes concerning the best kind of ML programs have developed, while the criticisms tend to focus on ML's peripheral elements and implied outcomes (e.g., stifling individuality).

In this essay I intend to present a functional analysis of Mastery Learning; an analysis which indicates that there is plenty of room for everybody under the ML umbrella. At the same time, however, I believe there is but one concept called Mastery Learning.

What is a functional analysis? In simplest terms a functional analysis examines why things are rather than what they are. In this case a functional analysis would examine the rationale for including various components in an ML program, rather than the description of the components per se.

For example, everyone in the field knows that formative tests comprise a critical component of Mastery Learning. When examining formative tests descriptively, one focuses on the way the tests look; e.g., formative tests typically are 20-item, multiple-choice, paper and pencil tests based on an underlying hierarchy of content elements and skills. Such a descriptive focus would lead quickly to a technology of formative testing and a willingness to exclude tests that don't look as they should. As we all know, this technology has been and is being developed, and the exclusionary perspective has been adopted by many. Sometimes, in fact, the exclusionary perspective is even assumed by the person being excluded, as was the case when a teacher informed Ben Bloom that she was "not doing Mastery Learning" in her writing class because she didn't use formative tests. Rather, she "just let the students write essays," collected them, indicated errors and misunderstandings, and had the students rewrite the essays until she was satisfied. One may ask how this teacher could not recognize that she was using at least a portion of ML, perhaps the key portion. The answer resides in the descriptive approach many have taken to defining Mastery Learning.

If we looked at formative tests functionally, what would we see? The major function they serve is to monitor student learning. Formative tests permit teachers to be able to identify learner progress vis a vis the unit objectives. Which students are learning what? Are there objectives being missed by a large proportion of students? Are there any clues as to where the difficulties might lie? Any instrument, method, or procedure that fulfills this function is appropriately termed a formative test.

Please examine the following table. I contend that an examination of the functions displayed in the right hand column of the table presents a much more meaningful "understanding" of what Mastery Learning is than does an examination of either the components themselves or the technologies that have developed around the components.

A Functional Analysis of the Key Components of Mastery Learning

COMPONENTS	FUNCTIONAL ANALYSIS
1. Assumptions and Propositions	1. Estimating feasibility of proper planning and execution of program
2. Objectives, Tests, Teaching - Learning Activities, Mastery Performance Standards	2. Communicating expectations to student, teachers, administrators and parents
3. Learning Units	3. Teaching of new content/objectives within larger context; presenting interrelationships among content objectives
4. Sequence of Learning Units	4. Teaching content/objectives which are at appropriate levels of difficulty; relating new learning to prior learning
5. Formative Tests, Performance Standards	5. Monitoring student learning; making instructional decisions based on evidence
6. Correctives	6. Helping students overcome errors and misunderstandings before they accumulate and interfere with future learning
7. Summative Tests, Performance Standards	7. Gathering cumulative information to use in grading students; grading relative to learning not relative to other students

I can think of at least two additional benefits to employing a functional analysis of ML: First, a functional analysis permits "restrained flexibility" in the development of ML programs. Since the operationalization of the various components need not look like other operationalizations but must serve the same function, a variety of objectives (both itsy-bitsy and biggy-wiggy), approaches to sequencing (hierarchical and non-hierarchical), and types of tests (multiple-choice, essay, and observational) are all possible and appropriate. Such flexibility may disturb some purists who expect to "see certain things" when they look at ML programs. "How will we ever be able to determine whether a program is, in fact, an ML program?" they may ask. My response is that a functional approach places even greater constraints on the developers of ML programs, since they are required to demonstrate that variations in the operationalization of the components serve the same function as the original operationalization.

A functional analysis provides for a second additional benefit. It is apparent that certain types of operationalization are "dysfunctional" in certain settings, but these same operationalizations may be quite functional in other settings. As a consequence, much of the debate between advocates of learner-responsive approaches and group-based approaches to ML would be moot within the framework of a functional perspective. It was no accident that Keller's PSI (basically, a learner-responsive approach) and Bloom's group-based approach were developed for, and embraced by, higher educational institutions and elementary-secondary institutions, respectively. Keller's PSI was much more likely to be functional in a typical college setting than in a typical elementary-secondary setting. Similarly, Bloom's approach was more likely to be functional in a typical elementary-secondary setting, especially settings like those in South Korea with 80 students per classroom. Bloom's approach required little in the way of altering the setting, but learner-responsive approaches in such schools would have required large scale setting changes. Hence, learner-responsive approaches are likely to be functional only when these setting changes are possible.

In summary, then, a functional perspective permits one to match the particular operationalization of Mastery Learning to the setting for which it is intended. By avoiding obvious mismatches of operationalizations and settings, increasingly effective mastery learning programs can be developed. These mismatches can be eliminated either by changing the operationalization to fit the setting or by changing the setting to accommodate the operationalization. Somehow this seems to be a return to the SpadyAnderson dispute (as to whether change should be evolutionary or revolutionary) which Tom helped launch the creation of the Network for Oucome-Based Schools in early 1980.

I believe that functional analysis of Mastery Learning is both necessary and long overdue. We need to concern ourselves more with why various components are included in an ML approach to instruction and less with what the components are, what they look like, and how we can improve upon them technically. This is not to suggest that the components themselves and the technology surrounding them are not important; rather, it is a question of priorities. If we don't know why something is included in an operational model, it makes little difference how nice it looks or how technically sound it is. Or, to paraphrase a famous poet, one performance standard doth not a Mastery Learning program make.

Finally, a functional analysis implies that there is no right way to "do" Mastery Learning. Instead there are many ways — each consistent with one's own values, but each functionally accurate and effective. So, there is plenty of room for all of us in this thing called ML if we want to find the room, and one way to find this needed room is to view ML and ML programs from a functional perspective.

A DISCUSSION OF MASTERY LEARNING

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Q. What is Mastery Learning?

A. Mastery Learning is a teaching/learning strategy that can be implemented in the traditional classroom setting.

Q. Can you be more specific? What is the main difference between Mastery Learning and other approaches to teaching?

A. There are many differences; however, the most important difference is philosophical. Mastery Learning is based on the premise that aptitude is proportional to learning rate and with specific cognitive and affective prerequisites most students can achieve a high level of competence ("A" work). This is quite a departure from the attitude of the typical college professor. The traditional expectation is that about a third of the class will do "A" or "B" work, about a third will do "C" or "D" work, and about a third will do "F" work or withdraw from the class.

Q. How did this idea of Mastery Learning originate?

A. Actually, the notion of Mastery Learning is not new. Although Dr. Benjamin Bloom developed the approach we are currently using in the City Colleges of Chicago, we find the idea that all can learn and learn well in the writing of early educators/philosophers such as Comenius, Pestalozzi, Herbart and Lock, and contemporary figures such as Washburne and Morrison.

Q. What then is Bloom's Mastery Learning strategy?

A. The theoretical basis for Mastery Learning was provided in 1963 by John Carroll (then of Harvard University). Based on Carroll's "Model of School Learning," Bloom said that for teachers to develop a viable Mastery strategy they must deal with the following five vari ables: (1) aptitude, defined as the amount of time required by students to attain Mastery (2) quality of instruction (3) students' ability to understand the instruction (4) perseverance, measured by the time the students are willing to spend in learning; and (5) the time allowed for the students to learn.

Q. That's all very theoretical. In terms of preparation by teachers, what must they do?

A. In the City Colleges of Chicago we help teachers prepare the materials necessary for a Mastery course through Mastery Learning Workshops or Mastery Learning Seminars. In the workshops and seminars teachers are guided in the preparation of the following:

(1) absolute standards for grades;

(2) division of the course topics into units;

(3) development of objectives for each session;

(4) analysis of the structure of the course utilizing Tables of Specifications for each unit;

(5) formative quizzes and a parallel retake's based on the unit objectives;

(6) statement of correctives for each of the formative quiz items;

(7) the development of Summative Evaluation based on the course objectives.

Q. Many of these terms are unfamiliar. Could you explain each in detail? What are and how are absolute standards developed, for example?

A. All Mastery Learning strategies require that absolute grading standards be established at the outset of the course. To establish valid standards, teachers are advised to examine previous examinations and objectives. The concept is that students work up to a standard of performance not that the standard be lowered to the students' level of performance. Standards are based on two sources: first, the overall course objectives, and, second, the past experiences of the teacher with students and the subject matter.

Q. Next, you mentioned dividing the course into units. How is this done?

A. In our workshops, we ask teachers to list the topics in their course. Next, these topics are divided into 16, 32, or 48 lessons (48, if the class meets three times weekly). Then these lessons are grouped into units, with each unit equivalent to approximately two weeks of class work. Therefore, there would be about eight units in a course.

Q. What benefit is derived from dividing a course into units or lessons?

A. The idea is to break up the course into digestable bits. This makes learning the material easier for students, and teaching easier for the teacher. The end of the unit provides a convenient point for both the student and the teacher to pause and evaluate their progress. If the students progress is unsatisfactory, some remedial action is taken.

Q. Is it necessary to use instructional objectives in developing a Mastery Course?

A. I believe that if teachers don't know exactly where the students are going, how are they going to tell when the students get there? Furthermore, sharing objectives with students is a great teaching aid. (If students know the objectives of a course, they are more likely to participate in their own learning and to utilize their study time more effectively and efficiently.) In our workshops we guide teachers in the development of specific performance objectives. We ask that they develop 90 to 150 objectives for their course. We use Preparing Instructional Objectives, by Robert F. Mager (Belmont, California: Fearon Publishers, Inc., 1975), as a guide for writing these objectives. Good objectives state in as specific terms as possible what students need to do to demonstrate that they have attained the objectives. Objectives are important because both formative and summative examinations are based on them.

Q. You mentioned Tables of Specifications along with units. What are they?

A. A Table of Specifications is a two-dimensional chart showing the relationship between the topics in your course and the levels of Bloom's *Taxonomy of Educational Objectives: Cognitive Domain*. The first step in constructing a Table of Specifications is to list the categories of Bloom's *Taxonomy* across the top of the page. Next, you list the appropriate categories. In this way you indicate the level of cognitive functioning you will require of your students in mastering the various topics. Finally, if a particular topic is a prerequisite for a subsequent topic, you draw a line between the to indicate that the topic at the lower level must be mastered first. For example, students must know how to add, subtract, multiply, and divide before they can master the solution of simple equations. A well constructed table of Specifications is the blue print of the unit. Generally, Mastery Learning instructors develop one Table of Specifications for each unit in their course.

Q. Next, you mentioned Formative Evaluation. What is this?

A. Most often they are quizzes, that is, brief diagnostic tools designed to inform both teacher and students what each student has learned and what each needs to study more thoroughly. Though these quizzes are usually multiple choice, other approaches can be used if they are required by the subject matter. For example, if you are teaching composition, the basic skill you are trying to teach is writing, so your evaluation instruments must test the students' ability to write. A multiple choice quiz wouldn't be that helpful, but a short essay would. Whatever their form, formatives are given at the end of each unit and are based upon the unit's table of specifications. Ideally, formatives are not counted toward a student's final grade. It is very important to score the formatives and to return them so that students can begin to work on any learning deficiencies revealed by the formatives.

Q. As I understand it, each Formative Evaluation is followed by a Corrective. Therefore, for each unit a teacher typically gives a quiz and then follows this quiz with something called a Corrective. What is a Corrective?

A. Correctives are specific assignments keyed to each item on a corresponding formative. They direct students to alternative learning experiences that will help them correct any deficiences revealed by the formative. Correctives are additional assignments specific to each student. Students only do those correctives that correspond to items that they have missed on the unit formative. Alternative Learning experiences means any method of presenting the material other than the way in which it was originally presented. Because some students did not master the material, it may be that their learning style is at odds with the original manner of presentation. Presenting that material to them in exactly the same way a second time may not be helpful. Correctives are the main method of remediation in Mastery Learning; thus we say that we give group instruction, but individual remediation. As you can see, this approach makes for a very efficient use of class time. We recommend that students do their correctives in small group sessions.

Q. What is a small group session?

A. The name is self-explanatory; it is what occurs when students come together in groups of 3 to 5 to study what is important. Research has shown that "peer-tutoring," as it is also called, is one of the most effective ways for students to learn.

Q. Let's discuss the materials required for a Mastery class. After the correctives, do the students get another opportunity to demonstrate that they have mastered the material for the unit?

A. Yes, on a second quiz. To distinguish this quiz from the first formative, we call this a "retake." Retakes are diagnostic tools that parallel the formative quiz to determine if the correctives have helped the student remedy the deficiences revealed by the formative. Students who do not demonstrate Mastery on the retake are referred to more intensive remediation. Typically, this completes the formative-corrective-retake cycle that occurs at the end of every unit.

Q. As I understand it, Summative Evaluations determine student grades.

A. Yes. According to a standard model of Mastery Learning, one summative is given at the end of the course. In practice, many teachers administer a small number of summatives (usually 2 or 3) at intervals throughout the term. When teachers develop these tests, they base them on previously used exams and modify them if necessary so that the material shown on the Table of Specification is covered. This helps to ensure that the instructor does not write a new course but simply adapts an existing course to Mastery techinques. A cogent argument can be made for administering a single Summative Examination at the end of a course instead of administering two or more Summative Examinations and averaging these grades at the end of the course. (students are actually penalized for knowledge and skills they possess at the end of the course, but did not possess earlier in the course.)

Q. Are there any other materials that Mastery Learning Teachers develop?

A. They develop materials such as the TOPICAL OUTLINE and ORIENTATION NOTES. The topical outline is a list of the topics to be covered during each class period and in homework assignments. The orientation notes are an introduction to the course, to Mastery Learning techniques, and to special ideas such as the small group study sessions. Orientation notes also include the grading scale, any rules of classroom behavior the teacher may wish to emphasize, and procedures for making up tests and the like.

Q. Let's turn now to the application of the Mastery Learning theory. Just how is a Mastery class conducted?

A. The teacher hands out the orientation notes, the topical outline, and the course objectives. It is a well-known fact that how students view their ability to learn a subject will determine how well they do so. If they feel that they "just can't do it," they are less likely to persevere. We've all had students whom we felt could do well in our course if they would only try, but they came to us thoroughly convinced that they would fail. Highly motivated students, on the other hand, are the ones who persevere; they're the ones who believe that they can succeed if they try. So, the Mastery Learning teacher must convince all the students that they are in control of the grade they will receive. With full participation in the class, everyone can earn an "A," especially since everyone will know what will be expected of them.

Q. Do you mean that students either receive an "A" or fail?

A. No. Students in Mastery courses receive the full range of grades. But, it is important for the student and the teacher to focus on the "A" grade, because it is this grade which demonstrates mastery of the material. This is a worthy goal that our students will begin to work toward once it is presented to them. For many of our students, the very idea of earning an "A" seems to be wholly new.

Q. How do you keep student motivated?

A. Success is the best motivation. The entire first unit is critical. Mastery teachers should work very hard to ensure that their students achieve mastery or near mastery of the material in the first unit, especially on the Formative. High scores will boost the morale of all the students — especially those who are unsure of themselves. Incidentally, we encourage teachers to give CERTIFICATES OF MASTERY to students who achieve mastery of the unit on the formative. Certificates of Mastery are attractive, diploma-like documents that read, "John Doe has achieved mastery of the XX unit in the class." The teacher signs them and presents them in class with great fanfare. As silly as it may sound, it works! It develops peer - group support and provides immediate recognition for the student. This is extremely important because the main recognition, the grade for the course, is several months in the future.

Q. Should the teacher do the tutoring?

A. If there are no other alternatives, yes. But it is preferable to use the Mastery Learning Manager or other tutoring services in the school. It is best to arrange for small peer-group tutoring sessions. This can be done if the teacher assigns each student to a group consisting of three to five students. Each group then sets its own time to meet immediately before or immediately after class. Mastery Learning Managers can be used to monitor these groups.

Q. Are all of these components necessary before a course is considered to be a Mastery course?

A. Our experience indicates that most teachers who are successfully using Mastery techniques have developed, to a very high degree, each of the above components.

However, in the broadest sense, a course is a Mastery course if a teacher adopts the philosophy that all students can master the course objectives, and if the teacher makes an effort to modify the teaching techniques so that students can spend the time necessary to achieve the desired objectives.

Q. How difficult is it for a teacher to develop the needed Mastery Learning Materials?

A. That depends on the teaching materials the teacher has already accumulated. For teachers who have been teaching a course for several semesters, almost all of the hard work will already be done. It then becomes a job of selection and organization.

Q. You have said that Mastery Strategies allow the individualization of group-based instruction. Can you explain?

A. At the end of each unit, after the teachers have presented their material in the usual way, they give a formative quiz, score it, and return it immediately to the students. (Mastery Learning Managers can be very helpful if the test has an objective format). At this point the teacher awards certificates to those who have mastered the unit and correctives to those who have not achieved mastery. After the students do the corrective learning task, they are given another opportunity to demonstrate mastery on an alternate form of the formative test. This cycle begins again with the next unit of instruction. Individualization takes place in the corrective phase, where individual attention can be given to those students who need to spend more time and work mastering the objectives for that unit.

Q. Suppose some students do not demonstrate mastery after they retake the parallel formative. Do you reteach the material?

A. It depends on the number of students who fail to achieve mastery. If a large percentage of the class is having difficulty with a particular concept, I think it is efficient to reteach; however, if only a few students are having difficulty, then it is probably better to have them tutored.

Q. How difficult is it for a teacher to implement a Mastery Learning course?

A. That depends on the teacher and on his or her style of teaching. The first time mastery is used will likely present problems that are new to the teacher, but none of those problems are insurmountable. By the third or fourth semester of the use of his/her mastery learning materials, most teachers find that everything works quite smoothly. One new teacher says that Mastery Learning is the only approach to teaching that makes sense to him, and a teacher with more than 25 years teaching experience proclaims that Mastery Learning re-kindled her enthusiasm for teaching. Both are getting remarkable results.

Q. Can Mastery Learning be applied to the affective domain or to the psychomotor domain?

A. Some teachers have developed and successfully used mastery techniques in courses in photography, electronics, typing and even counseling, but our experience is mainly in mastery techniques were applied to the cognitive and not to the affective domain.

Q. Won't Mastery Learning add to grade inflation?

A. I don't think so. The complaint about grade inflation is that grades no longer represent the level of competence they once did. In a mastery class, the standard of performance is set at the beginning of the course and the grades are based on the students' mastery of the course objectives, not on their relative performance in the class. So, if every student in the mastery course receives and "A," you may be sure that every student in that class has EARNED an "A." Moreover, when the "A" students from Mastery classes go on the sequential non-mastery classes, they do as well as any "A" student.

Q. Doesn't Mastery Learning short-change the better student?

A. Not if teachers allow the better students to help the slower students and if teachers design some enriching activities for these students. As many teachers have discovered, one gains a deeper, clearer and more thorough understanding of a subject by teaching it. Students teaching students is what takes place in the small group study session. Brighter students are given the opportunity to assume the role of a teacher in a minor way. Since they gain recognition from their peers when they do, they are motivated to take on that role. Further, the formative quizzes reveal the bright students early enough so that the teacher can provide them with enrichment activities.

Q. Does the Mastery Learning technique work better in some subjects than in others?

A. It is probably easier to develop materials and to implement a mastery technique in some subjects than in others, but if the subject is teachable, mastery learning is a useful technique. It is probably easier to develop and implement mastery techniques in the "basic" courses than in the "advanced" courses because the more advanced courses depend more heavily on prior learning than do the beginning courses.

Q. With all the objective tests that Mastery Learning uses, when will students get a chance to practice writing skills?

A. Teachers can use objective-type tests if they want to or they can use other techniques if that is more suitable. The choice is theirs. There is nothing in mastery that requires the use of objective tests. If writing is an objective of the course, or if the teachers include the students' writing skills in determining the students' grade, then teachers should state this fact explicitly and structure both the course and the tests to give the students the practice they need.

Q. Since Mastery Learning techniques are so structured, doesn't that restrict creativity and spontaneity?

A. Mastery Learning provides only the structure. Within that structure teachers and students can be as creative as they ever were. In the development of the correctives, teachers who use a Mastery approach are going to need all the creativity they can muster. Remember, we don't increase creativity by sacrificing precision or by removing the requirement that students master the material.

Q. How do you respond to the criticism that Mastery Learning teaches for the test?

A. Mastery Learning teaches for the course objectives. Since the entire course is structured around what the student should know by the end of the course, it appears as though Mastery teaches for the test. Every teaching strategy evaluates students based on what they were taught. Mastery clarifies the connection between the test and what is taught.

Q. Even with all the support you provide to teachers using Mastery Learning Techniques, and with the three hours lane placement credit Techniques lot of work. Yet, many teachers in the City Colleges of Chicago are using the technique. Why?

A. Because it works. In nearly every case, and in nearly every subject area in which the approach has been tried, Mastery has improved the academic performance of students and has decreased the likelihood of the students' dropping out. There isn't a teacher alive who doesn't get a thrill out of seeing students perform well. The biggest thrill of all is watching a student the teacher though was a "hopeless case" turn around and get decent grades for the first time.

Q. Is there any statistical evidence to confirm that?

A. Absolutely. We've collect data from Mastery Learning classes taught in the City Colleges of Chicago from 1972 up to the present, and we have compared the grades and retention in those classes with the grades and retention data from classes taught using more traditional teaching techniques. In the majority of the cases, the students in the mastery classes received higher grades and dropped out less than did students in the traditional classes.

Q. Is there any other comment you care to make?

A. Yes. In the final analysis, no matter what the school or the teacher does, it is the student's efforts that make the difference. However, Mastery Learning says to the student, "if you participate, you will succeed; you will get an "A."

STRENGTHS AND WEAKNESSES OF MASTERY LEARNING

Research and pratice have defined certain strengths and weaknesses of Mastery Learning. The following summaries will cover these strengths and weaknesses as delineated in the Mastery Learning literature, and as perceived by teachers in the City Colleges of Chicago.

PHILOSOPHICAL DIFFERENCES BETWEEN MASTERY LEARNING, P.S.I, AND TRADITIONAL INSTRUCTION

"Learning for Mastery"

-Education should insure all students learn those things society determines are important to learn (equality of outcomes).
-The individual's aptitudes for learning can be altered.

Personalized System of Instruction

-Education should encourage all students to learn as much as they can.
The individual's aptitude for learning is fixed.

Traditional Instruction

-Education should provide opportunities for all students to learn (equality of opportunity).
-The individual's aptitude for learning is fixed.

STRENGTHS OF MASTERY LEARNING AS REPRESENTED IN THE MASTERY LEARNING LITERATURE AND RESEARCH

1. Research favors Mastery Learning in the acquisition of cognitive skills in subject areas examined.
2. Mastery Learning reduces the amount of variability in achievement.
3. Mastery Learning increases retention within a class.
4. A few studies show Mastery Learning is better at developing ability to transfer learning.
5. A few studies favor Mastery Learning in improving student attitudes.
6. Slow learners improve their rate of learning.
7. Students spend a larger proportion of their time in active learning.
8. Some evidence shows varied correctives are more effective than continued practice on the same materials.
9. Mastery Learning works very well with courses that are sequential.
10. Interest, attitudes, and self-concept toward subject matter increases with success in Mastery Learning.

WEAKNESSES OF MASTERY LEARNING AS PRESENTED IN THE MASTERY LEARNING LITERATURE AND RESEARCH

1. Some evidence indicates that Mastery Learning students grow less interested in the subject matter after instruction.
2. Some criticism indicates that Mastery Learning retards progress of brighter students.
3. Some claims are made that mastery learning only works with objectifiable or technical skill type courses, that it is less successful with less sequential courses demanding more divergent thinking.
4. Some claims are made that the curriculum cannot be covered in the same amount of time as traditional methods. In Mastery Learning, teachers may need to provide more time on core content.
5. Most research supporting Mastery Learning involves short amounts of treatment time:

1/3 of the studies - treatment time is two weeks or less
1/3 of the studies - treatment time is two to four weeks
1/3 of the studies - treatment time is the entire school year

6. Some claims are made that Mastery Learning students show more anxiety about final exams.

STRENGTHS AND WEAKNESSES OF MASTERY LEARNING AS PERCEIVED BY TEACHERS IN THE CITY COLLEGES OF CHICAGO

Below are some of the strengths and weaknesses of Mastery Learning as perceived by the respondents to a questionnaire administered at Olive-Harvey.

STRENGTHS

Mastery Learning

1. provides immediate feedback for the instructor
2. encourages peer tutoring
3. allows for an individualized teaching approach
4. encourages student responsibility for learning
5. is a systematic, organized, and supportive approach to course development
6. build student confidence

WEAKNESSES

Mastery Learning

1. teaches for the test
2. does not encourage students to accept responsibility
3. does not consider prerequisite entry behavior
4. presents problems in time management
5. suffers from a lack of institutional support
6. contains problems related to non-sequential course development
7. requires a vast amount of time to develop course material

IMPLICATIONS OF SUCCESSFUL IMPLEMENTATION

Mastery Learning theory suggests and small-scale studies confirm that when Mastery Learning strategies are implemented successfully, 80 percent of all students can attain levels of mastery ordinarily attained by 20 percent of all students. Further, the variations in school achievement will decrease. Instead of a bell-shaped distribution for achievement, there would be a skewed distribution with most students' achievement clustering at the high end. Work on Mastery Learning theory began with the assumption that different learners needed different amounts of time to learn a particular learning task. However, research has shown that when learners are approximately equal in their cognitive and affective characteristics and when the quality of instruction in optimal, there is little difference in the amount of time needed to master a particular learning task. Since mastery strategies do reduce the variability in cognitive and affective characteristics for subsequent learning, if instruction is optimal at each stage of instruction, then each student may be helped to learn school subjects to the same degree or level of competence, and even in approximately the same amount of time. Bloom argues:

> If humans are born equal or can become equal with regard to learning, the home and the school have responsibilities far greater than they have assumed in the past. If equality of learning is possible, then the selective function of schools must be largely abandoned in favor of the developmental functions which schools must increasingly serve. (HC+SL, p. 209)

This may be hard to accept in societies which accept the concept of widespread individual differences in school learning. Notions about learning inequality would no longer be a basis for sorting people into more favored and less favored categories, or for distributing scarce rewards.

Modern technologically oriented societies depend on schools and the educational process to develop the various types of competencies needed by the society. A society which needs large numbers of people with particular competencies cannot depend entirely on selection methods for finding such competencies. It must take the steps necessary to develop them. One of the implications of Mastery Learning theory is that these competencies can be developed. Mastery Learning theory does not address the important issue of which competencies are to be developed. In this sense it is value-free.

Mastery Learning theory specifies some of the conditions needed in the learner's school experience to bring him or her to a high level of competence on any specified subject or skill. Further, it suggests that a sizeable proportion of all students can be brought to a high level of development under appropriate conditions. No student need be earmarked for failure at the beginning of his or her educational career.

Research, such as John Easton and Thomas Guskey's paper, "Estimating the Effects of College, Department, Teacher and Course on Course Completion Rates," presented at the March 1982 AERA Convention, has shown that schools -- and individual teachers -- can make a difference in the learning outcomes of their students. Potentially, they can make a very great difference in the careers and lives of their students. Mastery Learning theory suggests that bringing most students up to a high level of competence can be accomplished with an actual saving of student time in the long run.

But the central issue is not a cost-benefit analysis of school learning. The central issue is what is worth learning in the schools and the means by which the learner's motivation and capabilities are fully engaged in the learning process. If a large majority of students learn a subject to a high level of competence it will be necessary to ask whether the time and effort required to learn a subject to a high level can be justified for the particular students, the school, and the society. The increased ability to control and determine the learning outcomes for our students places upon educators increased responsibility for providing a curriculum which is in the best interests of the students and the society.

Exercise 10.1

Critique Mastery Learning by defining, for yourself, its unique contributions, strengths, and weaknesses. This will fulfill Objective 10.1

AFFECTIVE INSTRUMENTS

Unit II of this Workbook discussed affective entry characteristics, those attitudes a student brings with him which affect how well he will perform in the course. Since successful experiences in school are likely to result in a positive academic self-concept and attitude toward the subject, the experience of successfully completing a mastery course should have improved the student's attitudes in both areas.

The affective instruments described in this section are designed to measure the affective consequences of your course. In building your own instrument, decide first what variable(s) you wish to measure (i.e., attitude toward the subject, academic self-concept, etc.). Next, try to select items that represent various degrees of that variable. For example, if you wish to measure academic self-concept in relation to your subject, select items that represent locations on a continuum from low to high academic self-concept. An item representing the lower end of that continuum would be "I have difficulty understanding this subject" (scored on a strongly disagree to strongly agree scale), while an item on the higher end of that scale would be "I have the ability to do very well in this subject" (also scored on a strongly disagree to strongly agree scale). Clarity in what you want to measure is essential to obtaining results that tell you something.

The subject matter affect test which follows will give you some ideas about which aspects of affective consequences you may want to assess, and how they might be assessed. It was developed by Dr. Caponigri for his Mathematics 103 course.

SUBJECT MATTER AFFECT TEST

STEPS:

1. Read each statement or question.
2. Decide which answer agrees most closely with your opinion.
3. Look at the answer spaces on your answer sheet.
4. Fill in the space which has the same letter as the letter beside your answer.

PART I

Select one of the following:

A. Among the poorest
B. Below average
C. Average
D. Above average
E. Among the best

1. How do you rate your ability in ___________ compared to other members of this class or the last class you have taken?
2. Where do you think you would rank in ________ among your graduating class in junior college?
3. How do you rate your ability in ________ compared to your close friends?

PART II

Select one of the following:

A. Most unlikely
B. Somewhat unlikely
C. Not sure either way
D. Somewhat likely
E. Very likey

4. How likely do you think it is that you could complete advanced work beyond two years of college in ______?
5. Do you feel you are the type of student who will be able to develop special talents in ___?
6. In order to become a professional _______ work beyond four years of college is necessary. How likely do you think it is that you could complete such advanced work?

PART III

7. What kind of grades do you think you are capable of getting in ___?

A. Mostly F's
B. Mostly D's
C. Mostly C's
D. Mostly B's
E. Mostly A's

8. Forget for the moment how others grade your work. In your opinion, how good do you think your work is in ___ ?

   A. Much below average
   B. Below average
   C. Average
   D. Good
   E. Excellent

PART IV

Select one of the following:
   A. Strongly disagree
   B. Disagree
   C. Uncertain
   D. Agree
   E. Strongly Agree

9. I like to be called on in ____ class and asked to discuss important issues.
10. I am satisfied with my ____ class work and performance.
11. I am encouraged with my ____ performance.
12. I try to do the very best work in ____ that I can.
13. Some of the most enjoyable part of the day is the time I spend in school.
14. I enjoy most of my school work and want to get as much additional education as possible.
15. I find school interesting and challenging.

PART IV (CONTINUED)

16. My school experience will be important in helping me reach my life goal.
17. I would like to learn more about ____ by taking higher level courses.
18. I would like to invite a ____ expert to speak to our class.
19. I would like to do extra reading in ___ .
20. Given the time, I would like to join a ___ club.
21. I would like to have student membership in some professional ____ organization.
22. I would like to read newspapers, magazines, and technical journals on topics in ___
23. I would like to learn more about ___ applications in education, science and business.
24. I would like to learn as much about ____ as possible.
25. I would like to discover new uses for ___ .
26. I would like to watch movies on ___ outside of class time.
27. I would like to spend more time in school working on ____ .
28. I would like to read books on the history of ___ .
29. I fell homework is necessary if one is to be successful in ___ .
30. I feel ___ is necessary to be successful in this society.

PART V

Select one of the following:
   A. Strongly disagree
   B. Disagree
   C. Uncertain
   D. Agree
   E. Strongly agree

31. I feel people who take ____ are smart.
32. I feel tutoring will help me pass this course.
33. I feel students are unsuccessful in ____ because they do not study.
34. I feel students are unsuccessful in __ because they do not do the homework.

35. I feel students are unsuccessful in ___ because they are unmotivated.
36. I feel students are unsuccessful in ___ because they are absent from class.
37. I feel upset and nervous in ___ class.
38. I find it hard to talk in front of my ___ class.
39. ___ is the type of subject that confuses me very easily.
40. My ___ teacher makes me feel that I am doing poorly.
41. I am bored most of the time in school.
42. I dislike school and will leave just as soon as possible.
43. I dislike most school subjects.

PART V (CONTINUED)

44. Most school learning has little value for a person.
45. I feel most ___ books are too difficult to read.
46. I feel my elementary school teacher created a dislike for __ in me.
47. I feel students are unsuccessful in __ because they do not like the teacher.
48. I feel students are unsuccessful in ___ because they are not liked by the teacher.
49. I feel students are unsuccessful in ___ because they do not understand the textbooks.
50. I feel most ___ can be learned without a teacher.

Exercise 10.2

Construct a test to measure the affective consequences of your course. This will meet Objective 10.2. (Optional)

EVALUATING YOUR OWN MASTERY LEARNING COURSE

No matter what the experts, or even your fellow teachers, say about Mastery Learning, you will probably not be convinced of its effectiveness until you see the consequences of using it in your own classroom. The following are two separate ways of evaluating your Mastery Learning course. The first is a questionnaire designed by the Mastery Learning Project to measure how closely teachers followed the Mastery Learning model. It will help you assess where you departed from Bloom's model, and which areas you might want to bring into closer alignment next time. For the questionnaire, see Appendix B.

The other is an instrument designed by Aikin Connor to measure whether a given teaching method is actually an improvement over previous methods, or whether it only appears to be better.

Exercise 10.3

Think about the Mastery Learning components presented in this workbook. Now compare and contrast your Mastery Learning strategy with your previous teaching strategy. This exercise will meet Objective 10.3.

COMPARISON OF MASTERY AND NON-MASTERY CLASSES

One way of measuring the effectiveness of your mastery class is to compare it to a non-mastery class, either one that you have taught or one that a colleague has taught in the same subject area. Clearly, if your mastery class has produced no greater student learning than the group-based methods, you may want to stop teaching for mastery. But if it has produced noticeably greater student learning, you may want to continue teaching for mastery and upgrade your program so that it produces even better results in the future.

Aiken Connor of the ERIC Clearinghouse for Junior College Information has adapted the median test to measure whether a given teaching technique has produced significantly better results than more traditional methods. It can easily be adapted to measure the effectiveness of Mastery Learning.

For this test, both the experimental (mastery) and control (non-mastery) classes take the same summative examination, and the scores for both classes are compared as follows.

Step 1. Find the median of the scores for both groups combined.

- a. Arrange the scores in order from low to high.
- b. If there is an odd number of scores, the median is the one in the middle. Thus, if the scores were: 78 80 85 90 93
  the median would be 85.
- c. If there is an even number of scores, the median is the average of the two most central values. In the example:
  73 78 85 89 90 95
  the median is 87, halfway between the two most central values, 85 and 89.
- d. If there are several scores the same, like this:
  78 85 85 85 85 90 93
  find the median by first deciding which of the scores is the middle; in this case, it's the third 85. The lower limit of the interval represented by 85 is 84.5. Since the median is the third of four 85's, add .75 (3/4) to the lower limit, 84.5. Therefore, the median for this group is 85.25.

Step 2. Subtract the number of scores in the experimental group below the combined median from the number of scores above. If more students in the experimental group scored below the combined median, stop here. The treatment was not successful.

Step 3. Repeat Step 2 for the control group.

Step 4. Add the answers from Step 2 and Step 3, and divide by 2. This is the average difference.

Step 5. If the number of scores above or below the median in either group is fewer than 10, subtract 1 from the average difference, as determined in Step 4.

Step 6. Square the difference found in Step 5 (or Step 4 if Step 5 is skipped.

Step 7. Divide the number from Step 6 by the number of scores in the experimental group above the median plus those below.

Step 8. Divide the number in the experimental group above the median plus those below by the number in the control group above the median plus those below.

Step 9. Multiply the number from Step 7 by the number from Step 8 plus 1.

Step 10. If the number from Step 9 is greater than 2.71, the two groups may be presumed to be significantly different -- the treatment was a success.

Exercise 10.4

Describe the procedure you will use to evaluate your mastery class. This will fulfill Objective 10.4.

A FINAL WORD

You have just finished designing your **Mastery** Learning course. Congratulations! We are sure that the time and effort you have put into thinking through your course in advance will result in a more effective and rewarding teaching experience.

But, as this section on evaluation points out, your job is not over yet. Before you teach this course again, you ought to go over it again and revise it. Was there a unit where the instruction was not as effective as it could be? Did each of the evaluations accurately measure the stated objectives? Could you add yet another alternative to the formative/corrective/retake cycles?

One of the advantages of the Mastery Learning technique is that the thorough preparation the instructor does the first time he teachers a class pays off in the long run. The structure of Mastery Learning clearly points out the areas of difficulty in a course, thereby reducing the amount of time needed for revision.

However, each teacher, mastery or non-mastery, will have to revise his courses regularly in order to ensure that they remain fresh and that they are as effective as possible.

Formative Quiz - Unit 10

1. How does Mastery Learning differ from P.S.I. (Personalized System of Instruction) in its assumption concerning student aptitude for learning?

   ----

2. Which type of instuction, Mastery Learning or traditional, has a primary goal of providing for equality of opportunity?

   ----

3. How does Mastery Learning differ from P.S.I. in the way each approach uses correctives?

Below are listed a series of claims made of the impact of Mastery Learning. For each statement, indicate whether it is SUPPORTED (S) or NOT SUPPORTED (NS) by research.

4. Mastery Learning reduces variability in student achievement.

   ____ S ____ NS

5. Mastery Learning increases retention in school.

   ____ S ____ NS

6. Mastery Learning develops the ability to learn in unfamiliar situations.

   ____ S ____ NS

7. Mastery Learning retards the progress of high aptitude and brighter students.

   ____ S ____ NS

8. Mastery Learning is most successful with objectifiable or technical skill type courses.

   ____ S ____ NS

9. Mastery Learning students show more anxiety about final exams.

____ S ____ NS

10. Slow learners improve their rate of learning in mastery courses.

____ S ____ NS

11. Time on task increases in Mastery Learning.

____ S ____ NS

12. Continued practice over the same material is not an effective corrective in Mastery Learning.

____ S ____ NS

13. How does successful completion of a course affect a students attitudes toward future classes? ____________________

ANSWERS

Formative Quiz - Unit 10

1. Mastery Learning assumes that student aptitude for learning is alterable; P.S.I. assumes it is fixed.

2. Traditional Instruction

3. In P.S.I. correctives are accomplished by returning the student to the original instructional materials. In Mastery Learning, supplementary materials and methods are used to teach the problematic material in different ways from the original material.

4. S

5. NS

6. S

7. NS

8. S

9. S

10. S

11. S

12. NS

13. Successful completion of a course should make a student feel more positive about the subject matter and himself as a learner.

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The following is a list of the works we consider the most basic readings in the field of Mastery Learning. It is necessarily incomplete, since it was intended to present only what we consider to be the most major works in the field. For a more complete Mastery Learning bibliography, contact the Mastery Learning Project, Room 1712, City Colleges of Chicago, 185 North Wabash, Chicago 60601.

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MASTERY LEARNING TEACHING METHODS SCALE (MLTMS)

Name ________________________ Mastery Learning Course and Number ____________________

Department ____________________ College __________________ Date __________________

This questionnaire is part of a study being conducted by the Mastery Learning Project to determine which of the various techniques that make up the mastery learning strategy are most important in facilitating student learning. The first part of the questionnaire asks you to rate these techniques according to their importance in your mastery learning strategy. The second part asks you about the way you implement these techniques. No one outside the project staff will ever see your questionnaire or learn your individual responses.

PART I

Each of the following items presents the name of a specific technique used in mastery learning, followed by a brief description of that technique. For each technique, check one of the five boxes, according to whether you have found that particular technique to be "Very Important," "Important," "Ambivalent," "Unimportant," or "Very Unimportant" in facilitating student learning.

	Very Important	Important	Ambivalent	Unimportant	Very Unimportant
1. TOPICAL OUTLINE: The topical outline briefly lists the topics you will cover in your course and orders them by when they will be covered.	( )	( )	( )	( )	( )
2. LEARNING UNITS: Independent or semi-independent sets of learning tasks, activities, or projects that students find comprehensible.	( )	( )	( )	( )	( )

	Very Important	Important	Ambivalent	Unimportant	Very Unimportant
3. TABLES OF SPECIFICATIONS: The topics within each learning unit classified according to a taxonomy of objectives. Typically the topics are listed vertically down the left hand column of a page, and the levels of a taxonomy are listed horizontally across the top of a page. The cells in the table represent the interaction between a topic and a category of the taxonomy. Bloom's Taxonomy of Educational Objectives is one such classification system that can be used to organize teaching and evaluation. The taxonomy provides six hierarchical levels within which course topics, objectives, and test items can be categorized. These levels are knowledge or recall, comprehension, application, analysis, synthesis, and evaluation. Sometimes the knowledge or recall level of the taxonomy is called the lower mental process level and other levels of the taxonomy are called higher mental process levels.	( )	( )	( )	( )	( )
4. BEHAVIORAL OBJECTIVES: Objectives stated in terms of students behaviors expected, the conditions under which the behaviors are to occur, and the criterion of acceptable performance.	( )	( )	( )	( )	( )
5. ORIENTATION: A process of introducing students to mastery learning demonstrating how it differs from conventional teaching and learning techniques. The orientation is designed to convince students they can "master" course learning tasks. Orientation notes may also contain course objectives, homework assignments, rules and regulations, and grading procedures.	( )	( )	( )	( )	( )
6. ASSIGNMENTS: Learning activities assigned to provide students practice in mastering the objectives of the course.	( )	( )	( )	( )	( )
7. FORMATIVE EVALUATIONS: Brief usually ungraded diagnostic tools designed to provide information on the degree of student learning of specific learning tasks. Formative evaluations are usually given at the end of each learning unit.	( )	( )	( )	( )	( )

	Very Important	Important	Ambivalent	Unimportant	Very Unimportant
8. **CORRECTIVES:** Alternative methods of instruction designed to provide additional time and practice for students with specific learning difficulties as diagnosed by formative evaluations. Every formative test item usually has a corresponding corrective. Correctives are learning activities designed to raise the level of learning accomplished by group instruction.	( )	( )	( )	( )	( )
9. **RETAKE FORMATIVE EVALUATIONS:** A second form of the formative evaluation designed to assess mastery for students taking correctives.	( )	( )	( )	( )	( )
10. **SMALL GROUPS:** Groups of approximately three to five students formed the purpose of working together on homework, correctives, and in general, studying the material in the course.	( )	( )	( )	( )	( )
11. **CERTIFICATE OF MASTERY:** An award certificate presented to students who have attained mastery of a unit.	( )	( )	( )	( )	( )
12. **SUMMATIVE EVALUATION (S):** This (these) evaluation (s) appraises the extent to which students have attained course objectives and determines the grade a student will receive for the course.	( )	( )	( )	( )	( )
13. **STANDARDS FOR GRADING:** Absolute standards set that reflect the percentage of course objectives that must be mastered to obtain specific grades.	( )	( )	( )	( )	( )

PART II

Each of the following items presents the name of a specific technique used in mastery learning, followed by a brief description of that technique. Following each description is a group of questions about the way you implement that particular technique in your mastery learning strategy. For each question check one alternative except where noted. Please note that some alternatives are followed by instructions to skip to other questions.

TOPICAL OUTLINE: This outline briefly lists the topics you will cover in your course and orders them by when they will be covered.

14. A topical outline has been developed/revised for:
    ( ) every lesson and unit of the course
    ( ) every unit of the course not for each lesson
    ( ) the course as a whole, but not for each unit or lesson
    ( ) no topical outline has been developed (if you check this alternative skip to question 16)

15. The time allowed for presenting each topic in the topical outline is:
    ( ) always sufficient
    ( ) usually sufficient
    ( ) sometime sufficient
    ( ) seldom sufficient

LEARNING UNITS: Independent or semi-independent sets of learning tasks, activities, or projects, that students find manageable and comprehendible.

16. Concepts within each learning unit are:
    ( ) strongly related to each other
    ( ) usually fit together
    ( ) sometimes concepts cannot be easily related
    ( ) the course is not taught by a unit method (if you check this alternate skip to question 20)

17. When teaching the learning units, students are:
    ( ) always made aware of the divisions between units
    ( ) usually made aware of the divisions between units
    ( ) sometimes made aware of the divisions between units
    ( ) never made aware of the divisions between units

18. Learning units in your course are EQUAL or UNEQUAL in length.
(circle your choice)

19. How many units are in your course? ________

TABLE OF SPECIFICATIONS: The topics within each learning unit classified according to a taxonomy of objectives. Typically the topics are listed vertically down the left hand column of a page, and the levels of a taxonomy are listed horizontally across the top of a page. The cells in the table represent the interaction between a topic and a category of the taxonomy. Bloom's Taxonomy of Educational Objectives is one such classification system that can be used to organize teaching and evaluation. The taxonomy provides six hierarchical levels within which course topics, objectives, and test items can be categorized. These levels are knowledge or recall, comprehension, application, analysis, synthesis, and evaluation. Sometimes the knowledge or recall level of the taxonomy is called the lower mental process level and other levels of the taxonomy are called higher mental process levels.

20. Tables of specifications have been developed and used in planning each unit of the course. These tables use:
( ) mostly higher mental process levels of a taxonomy
( ) an equal number of higher and lower mental process levels of a taxonomy
( ) mostly the lower mental process level of a taxonomy
( ) course content analysis does not make use of tables of specifications (if you check this alternative skip to question 22)

21. Tables of specifications are used to make students aware of the order in which tasks need to be learned in:
( ) every unit of the course
( ) most units of the course
( ) some units of the course
( ) the table of specifications is seldom used to make students aware of the order in which tasks need to be learned

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BEHAVIORAL OBJECTIVES: Objectives stated in terms of student behaviors expected, the conditions under which the behaviors are to occur, and the criterion of acceptable performance.

22. Behavioral objectives have been prepared for:
( ) every class period of the course
( ) every unit of the course but not for each class period
( ) the course as a whole, but not for each unit or class period
( ) behavioral objectives are not used in the course (if you check this alternative skip to question 24)

23. Behavioral objectives are distributed/discussed with students:
    ☐ for most class periods
    ☐ for most units of the course
    ☐ for some units of the course
    ☐ behavioral objectives are not distributed/discussed with students

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ORIENTATION: A process of introducing students to mastery learning demonstrating how it differ from conventional teaching and learning techniques. The orientation is designed to convince students they can "master" course learning tasks. Orientation notes may also contain course objectives, homework assignments, rules and regulations, and grading procedures.

24. The orientation plan contains:
    ☐ most of the elements listed in the definition above
    ☐ some of the elements listed in the definition above
    ☐ a few of the elements listed in the definition above
    ☐ an orientation has not been planned for the course (if you check this alternative skip to question 26)

25. Elements of the orientation are presented to students:
    ☐ in most class periods
    ☐ at least once for each unit
    ☐ occasionally thoughout the course
    ☐ in the course introduction only

ASSIGNMENTS: Learning activities assigned to provide students practice in mastering the objectives of the course.

26. Assignments have been planned for:
    ☐ every class period of the course
    ☐ every unit but not for each class period
    ☐ the course, but not for each unit or class period
    ☐ no assignments have been planned (if you check this alternative skip to question 28)

27. If collected, assignments are usually returned with:
    ☐ detailed evaluative comments
    ☐ brief evaluative comments indicating level of performance
    ☐ no evaluative comments
    ☐ assignments are not returned

FORMATIVE EVALUATIONS: Brief usually ungraded diagnostic tools designed to provide information on the degree of student learning of specific learning tasks. Formative evaluations are usually given at the end of each learning unit.

28. Formative tests items assess mastery of:
( ) every objective in each unit
( ) the most critical objectives in each unit
( ) a random sample of the objectives in each unit
( ) formative evaluations are not planned for this course (if you check this alternative skip to item 31)

29. Results of formative evaluations are used in determining course grades:
( ) formative evaluations are rarely or never used in input in determining course grades
( ) only if performance on the formative evaluation improves the course grade
( ) almost always
( ) ungraded formative evaluations are not planned for the course

30. Formative evaluations are:
( ) required for this course
( ) strongly encouraged
( ) encouraged
( ) optional and left up to the student to choose

CORRECTIVES: Alternative methods of instruction designed to provide additional time and practice for students with specific learning difficulties as diagnosed by formative evaluations. Every formative test item usually has a corresponding corrective. Correctives are learning activities designed to raise the level of learning accomplished by group instruction.

31. Correctives have been developed for:
( ) every objective or formative test item in each unit
( ) the most critical objectives or formative test items in each unit
( ) a random sample of objectives or formative test items in each unit
( ) correctives are not used formally in this course (if you check this alternative skip to item 34)

32. Typically, for each objective or formative test item students with a learning difficulty are exposed to :
( ) two or more alternate ways of presenting the course material
( ) one alternative way of presenting the course material
( ) a review and practice of the original material only
( ) correctives are not used formally in this course

33. Correctives are given to students with the intent that, when needed, they are:
( ) required for this course
( ) strongly encouraged
( ) encouraged
( ) optional and left up to the student to choose

RETAKE FORMATIVE EVALUATIONS: A second form of the formative evaluation designed to assess mastery for students taking correctives.

34. Retake formative evaluation items are developed to be parallel to:
( ) every original formative evaluation item or objective
( ) a large percentage of the original formative evaluation items or objectives
( ) only some of the original formative evaluation items or objectives
( ) retake formative evaluations have not been developed for this course (if you check this alternative please skip to item 36)

35. Retake formative evaluations, when needed, are:
( ) required for this course
( ) strongly encouraged
( ) encouraged
( ) optional and left up to the student to choose

SMALL GROUPS: Groups of approximately three to five students formed for the purpose of working together on homework, correctives, and in general, studying the material in the course.

36. Small groups are:
( ) set up and monitored throughout the course by the instructor
( ) set up by the instructor, but work only upon student initiative and interest
( ) mentioned as an idea, but are set up and monitored upon the initiative and interest of students
( ) not used in this course

CERTIFICATE OF MASTERY: An award certificate presented to students who have attained mastery of a unit.

37. Certificates of mastery are presented to students upon mastery of:
( ) formative and retake formative evaluations
( ) original formative evaluations only
( ) summative evaluations
( ) certificates of mastery are not used in this course

SUMMATIVE EVALUATIONS: This evaluation(s) appraises the extent to which students have attained course objectives and determines the grade a student will receive for the course.

38. Summative evaluations have been developed to test mastery of:
    ( ) every objective in the course
    ( ) the most critical objectives in the course
    ( ) a random sample of objectives in the course
    ( ) the course does not give a summative type of evaluation. (If you check the alternative skip to item 40)

39. Summative evaluations are given to students:
    ( ) at least three times in the course
    ( ) twice in the course
    ( ) once in the course

STANDARDS FOR GRADING: Absolute standards set that reflect the percentage of course objectives that must be mastered to obtain specific grades.

40. Standards for grading are set:
    ( ) before the course begins
    ( ) after some initial judgements of the ability level of the particular class
    ( ) after the results of the summative evaluation have been examined
    ( ) standards for grading are not based on the percentage of course objectives mastered (If you check this alternative skip to question 42)

41. Students are informed of the meaning of the grade they receive on a summative evaluation by:
    ( ) reporting a detailed account of objectives mastered and not mastered
    ( ) indicating mastery and non-mastery of critical objectives only
    ( ) giving general comments on overall course performance only
    ( ) students are not given explicit interpretation of their grade

42. Are there any modifications you have made to Mastery Learning components that you think have contributed to your being a more effective teacher? ____________________

____

____

____

____

43. Please describe other teaching methods you use in instruction with your students that you think have contributed to your effectiveness ____________________

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